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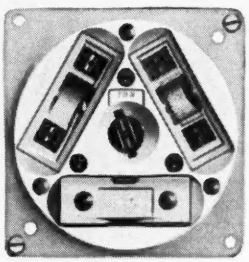
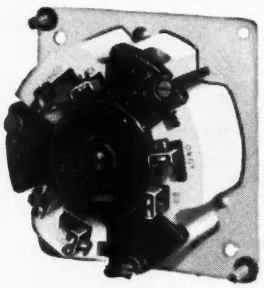
ELECTRICAL REVIEW

Splendid Isolation

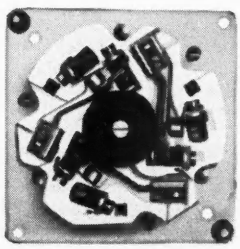
Attractively designed cover and cast iron case of the MEM Rotary Fused Isolator are finished in grey stove enamel.



Fuse inspection is absolutely safe. The fuse sockets are isolated by the removal of the cover and it is impossible to touch live metal.



Wiring is especially easy. Heavy clamp terminals are provided and are clearly identified. An indicator shows whether the switch is on or off.



The three phases of the robust cam operated switch are separated by thick porcelain walls. Contacts are solid silver. Inspection is simple once the plastic switch cover is removed.

Handsome appearance and high efficiency go hand in hand here, in the MEM Rotary Fused Isolator.

Designed for use with A.C. Motors on machine tools and other similar applications, this switch is of a slow break A.C. pattern rated at 15 amps., 500 volts. It will safely disconnect a stalled motor of 7½ h.p. taking six to eight times full load current.

The unit takes 15 amp., rewirable "Kantark Major" fuses or alternatively you can choose standard H.R.C. fuse links to the dimensions of B.S.88 1952, Appendix J.

Fuses can be inspected or renewed in perfect safety. The cover can only be removed when the switch is in the 'off' position, and then the fuse contacts are completely isolated from the incoming supply.

Two patterns are available, for flush or surface mounting.

MEM

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22 MARCH
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

Engineering Status	505	Better recognition of the value of the engineer to society would improve recruitment to the profession and industry
Graphical Field Plotting	507	Many engineering problems depend upon the solution of potential field distribution. When no analogue device is available the graphical method provides the designer with a valuable time-saving tool
Manufacturing Progress in 1956	513	Developments by the Metropolitan-Vickers Electrical Co., Ltd., last year included a generator with water-cooled stator windings and improvements in transformer design
Further Electricity Bill Amendments	516	Utilisation of surpluses; compensation provisions; entry to lands for survey purposes; speeding up road building procedure
Rectifier Locomotives	525	Advantages and disadvantages of different types of power circuit and a new approach to the solution of steady state and transient rectifier problems
Mains Frequency Induction Furnace	527	Birlec installation at the Derby foundry of International Combustion, Ltd.
Domestic Electrical Equipment—Vacuum Cleaners	536	Review of the wide range of models now available, with particulars of type, motor rating, accessories, price, etc. Many models are illustrated

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Power Station Trends	512	**Parliamentary Report**	534
Letters to the Editor	519	**New Electrical Equipment**	535
Batti-Wallahs' Ladies' Night	521	**Financial Section**	542
Personal and Social	522	**New Patents**	546
New E.D.A. Director	524	**Next Week's Events**	547
Nuclear 1,000 MW Stations Envisaged	529	**Contract Information**	548
Housecraft Advisers' Conference	529	*REGIONAL GUIDE TO ELECTRICAL CONTRACTORS*	105
Industrial News	530	*CLASSIFIED ADVERTISEMENTS*	109
Generation and Development	533	*INDEX TO ADVERTISERS*	120

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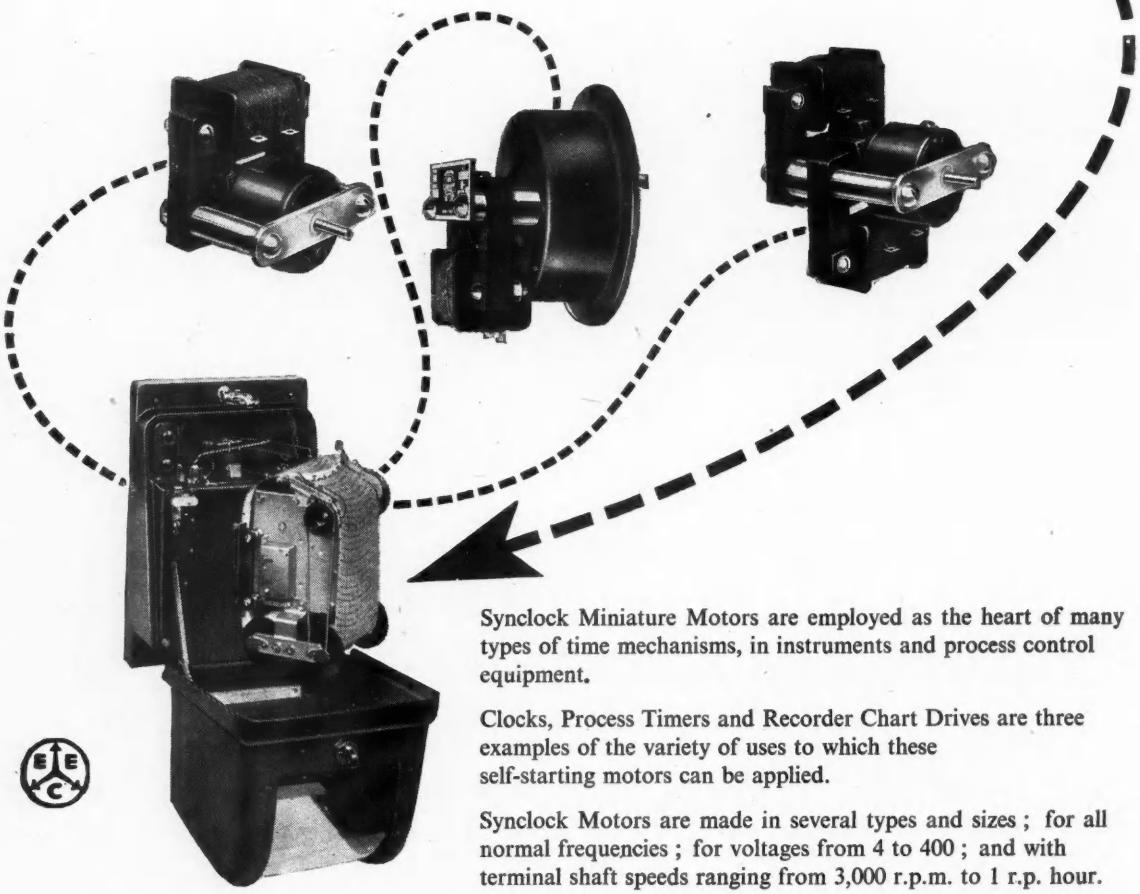
ELECTRIC SYNCLOCK

The power within . . .



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ELECTRICAL REVIEW

22 March 1957 Vol. 160 No. 12 Established 1872

Engineering Status

THE great amount of thought now being devoted to the education and training of engineers, if it can be translated into speedy action, should go far towards mitigating the consequences of past neglect. The spur to such action is a realisation that the future prestige and prosperity of this country depends upon the ability of its engineers to exploit fully and economically the unprecedented rapidity of scientific discoveries of recent years in face of foreign competition.

This raises the all-important question as to the quantity and quality of men equipped by training to grasp the implications of each technological advance as it comes along. The exciting possibilities for electrical engineers, as summarised by Dr. Willis Jackson in "Technology" (the new monthly journal published by *The Times*), should appeal strongly to youths looking forward to a truly worth-while career in the higher ranks of the profession and possessing the qualifications denoted by corporate membership of the Institution of Electrical Engineers. As a means of satisfying the educational and training requirements for a technologist, he draws attention to the alternative to university degree courses that is provided by technical college courses which can lead to the recently instituted Dip. Tech. (Eng.) granted by the National Council for Technological Awards.

Particulars of an address by the vice-chairman of that body, Sir Harold Roxbee-Cox, are included in this issue. In his introductory remarks Sir Harold points out that too many technological enterprises are controlled by non-technical men because the quality men with technical training are just not available. They are hardly likely to become so if, as has been estimated, 80 per cent of the most talented boys in public and grammar schools are taught no science. To leave only 20 per cent for application to the fundamental sources of national survival seems, as he states, stupid. Engineers as a whole are often criticised for taking too little interest in other aspects of life. Surely, however, the lack of any acquaintance with the elementary facts of science and its engineering applications, so often betrayed by the general public, is even more reprehensible and likely to be more injurious to a balanced outlook.

As a result of this deficiency in general education and a common misuse of the term "engineer," few are capable of appreciating the high intellectual capacity entailed in engineering leadership. There are definite indications that the withholding of adequate social recognition of such qualities hinders recruitment to engineering of young men of talent and initiative. It also influences those of high educational attainments, apart from science and its derivatives, who find natural difficulty in deciding policy and its financing. As Sir Harold says, "*No one* must grow up without *any* education at all in science." The italics are his: the opinion is strictly germane to the present issue.

THE E.D.A. DIRECTORSHIP

The impending retirement of Mr. V. W. Dale from the position of director and secretary of the British Electrical Development Association led to much discussion about the kind of man who should be his successor. Some were for an eminent public man, with or without knowledge of the industry, whose "weight" would ensure him (and incidentally electricity) a good Press. Others favoured the public relations officer type who would secure a good Press by subtler means, while there was a third party who thought that technical ability and thorough knowledge of the industry were the most valuable qualifications.

We are very glad to find that the views of the last-named section have prevailed and that the E.D.A. Council has selected Mr. J. I. Bernard, chief technical officer of the Association, who has worked closely with Mr. Dale for about thirty years. While it remains a propaganda body, E.D.A.'s character has changed considerably as electricity supply has advanced (largely due to its influence). People still have to be persuaded to use electricity but it has become more necessary to tell them *how* to use it. The Association's educational activities were intensified during the war and have really assumed first place. This is the side on which Mr. Bernard has made his mark and it is gratifying to see that this has been recognised by his appointment as director and secretary.

FUTURE OF NUCLEAR POWER

In a recent lecture to the Royal Swedish Academy for Engineering Sciences Sir Christopher Hinton indicated, in dealing with one of the latest sciences, how much future advancement depended solely on confidence in past work. The upward trend of reactor-can temperature would be made possible not by any improvement in the canning material or method of can fabrication, or by improvements in the metallurgy of the uranium fuel elements, but rather by the growing confidence which experience with Calder Hall had given and by independent support of fuel elements and departure from the Calder Hall system, in which the fuel elements were stacked one on top of the other. This advance would therefore be achieved rather by improvement in mechanical design than by advances in metallurgy.

Again, in referring to earlier work on conventional power stations, Sir Christopher said that when the late Sir Leonard Pearce was constructing Battersea "B" power station to work at turbine stop valve conditions of 1,350 lb/sq in and 510 deg C, many engineers (of whom Sir Christopher was one) said it was difficult to visualise that operating temperatures could be raised further. Yet to-day, steam at 2,350 lb/sq in and 560 deg C at the superheater outlet was being produced in modern boiler plants.

ATOMIC POWER COSTS

There has been much speculation about the "credit" for plutonium in the radiated fuel from the C.E.A.'s projected atomic power stations upon which the net production cost depends. Sir Christopher Hinton in his lecture disclosed a figure of 0·07d/kWh which placed against the total production cost of 0·73d/kWh makes the net cost per kWh 0·66d. He forecast that by 1970 the cost would fall to 0·47d/kWh and by 1980 to 0·38d. The heaviest single item of expenditure was said to be depreciation, based on 20 years' life and 5 per cent interest (0·37d); fuel replacement cost was put at 0·24d; 5 per cent interest on the fuel charge (0·06d); and operating expenses (0·06d).

It is practically impossible to compare the cost of the nuclear kWh with that produced in a coal-fired station, but the probability is that coal will get dearer and dearer while atomic fuel will fall in price as production methods improve.

ENTRY FOR SURVEY

"Between the moment when a new power station is conceived and its siting and broad characteristics decided, and the date it is completed, about eight years elapse." This was one of the findings of the Herbert Committee which proposed ways in which this wide gap could be contracted. Some of the causes were shown to be internal, but the time taken to secure approval of sites is generally a serious handicap. The Committee said that it would regard with misgiving any possibility that the criticised methods and procedures might be adopted for the development and construction of nuclear power stations.

It was apparently with this in mind that the Government last week added a new clause to the Electricity Bill empowering the electricity authorities to enter land for survey purposes when necessary. If they could not obtain voluntary permission they could exercise their powers of entry after giving 24 hours' notice. Although Mr. Maudling explained that this would in no way delegate the existing procedure for obtaining planning consent or give a general absolution from the law of trespass, there was considerable opposition to the new clause from both sides of the committee considering the Bill.

There is some doubt whether this right of entry will greatly shorten the present procedure and even if it does it should be very tactfully exercised. Recent cases have shown how carefully such matters have to be handled.

FALL IN ELECTRICITY OUTPUT

Last month, for the first time for several years, electricity output was well below the figure for the corresponding month of the previous year. The usual Ministry of Power returns, published on page 533, show that 7,889 million kWh was generated in February compared with 8,809 million kWh in the same month of 1956, a reduction of 920 million kWh, or 10·4 per cent. In the latter case there was an extra day owing to Leap Year which would account, on a daily average basis, for roughly 300 million kWh. Less easy to measure is the effect of the contrasting weather conditions; while last month was generally mild, in February, 1956, there was a prolonged period of severe weather. Allowing for these factors, it would seem that there has nevertheless been some slackening in rate of expansion in consumption which has recently been lower in mainly industrial areas than elsewhere.

Graphical Field Plotting

Application to Electrical Design

By E. G. WRIGHT, A.M.I.E.E., A.M.C.T.

AN important range of engineering problems depend upon the solution of the potential field distribution. These include electrical and mechanical stress distributions, capacitance of electrode systems, heat flow through insulation, reluctance and inductance of magnetic circuits, fluid flow, etc.

A large number of mathematical solutions for particular field distributions are available,[1-3] but in the general case other methods such as graphical field plotting or experimental analogues must be used because of the mathematical difficulties. Although recent developments in the analogue methods, particularly the electrolytic tank, enable the majority of engineering potential field problems to be solved with a reasonable expenditure of time and effort, some experience of the graphical and mathematical methods is still desirable. If no analogue device is available, the graphical method is a very valuable aid to the solution of engineering problems.[4, 5]

Simple Plotting Technique

Consider electrode boundaries of known potential, as shown in Fig. 1, and assume that they are of infinite length in the axial direction, i.e., a two-dimensional field. The solution of this field is a solution of the two-dimensional Laplace equation

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0$$

but a mathematical solution is not possible for the boundary conditions in this case.

It can be shown that if a set of equipotential lines and flux lines are drawn to form a continuous system of curvilinear rectangles between the boundary electrodes, a solution of the field has been obtained. A curvilinear rectangle may be defined as an area bounded by two pairs of curves belonging to two mutually orthogonal families of curves, which on subdivision become nearer and nearer to true rectilinear rectangles. For simple two-dimensional fields it is convenient in sketching to make the curvilinear reactangles curvilinear squares.

The procedure is to draw one or more equipotential lines to suitably divide the area between the boundaries, and then draw in flux lines to cross the equipotential lines at right angles, and form curvilinear squares as far as possible. The first trial will not give curvilinear squares throughout and the lines are corrected by trial and error until the curvilinear squares are obtained over the whole area.

Fig. 2a shows the first trial solution for Fig. 1. The lines are started between the parallel portion of the boundary where the field would be expected to be uniform, and it is found that with the trial equipotential line as shown, the flux lines cannot form curvilinear squares on both sides of the equipotential line. It is obvious that the equipotential line should be moved up in the direction of the arrow. Fig. 2b shows a further trial and it is clear that a further upward movement is necessary. After

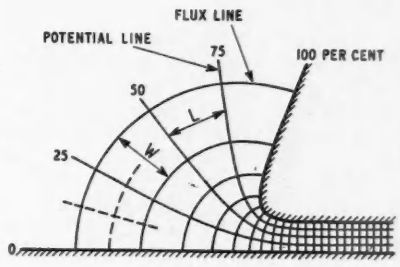


Fig. 1.

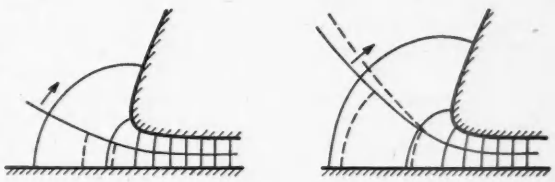


Fig. 2.

moving the equipotential line to the dotted position a reasonably satisfactory solution is obtained. After further subdivision and any necessary correction, the plot shown in Fig. 1 results.

In Fig. 1, the space between the electrodes is divided into curvilinear squares and it can be seen that:—

(a) All equipotential lines and flux lines cross at right angles.
(b) For any curvilinear square the mean width W between flux lines is equal to the mean length L between equipotential lines.
(c) All flux lines meet the boundary electrodes normally.
(d) The large curvilinear squares can be subdivided to give smaller curvilinear squares.

The drawing is, therefore, a complete solution of the field and the curvilinear squares have the following important properties, assuming unit depth of field perpendicular to the plane of the paper.

(1) The potential difference between equipotential lines across all curvilinear squares is the same.
(2) Equal quantities of flux pass through all volumes formed by the curvilinear squares.
(3) The capacitance, permanence, resistance, etc., of each curvilinear square is the same.
(4) The energy of each curvilinear square volume is the same.
(5) The flux density and electric field strength vary throughout the field inversely as the size of the squares.

It is usually advisable to draw the electrode boundaries in ink on one side of tracing paper and then in pencil draw a coarse plot to establish the general shape of the field. Some knowledge of the approximate shape obtained from a study of published solutions is desirable before starting. Then on the other side a good coarse plot is obtained by rubbing out and redrawing the lines as required. The coarse plot is then subdivided and corrected where found necessary.

The arrangement should be inspected for constructional symmetry and care taken to consider the complete field

and not just a local part. The curvilinear squares can be formed and checked by the use of compasses or dividers and the correctness of the right-angle tangents carefully watched by looking squarely down on to the paper.

Basic Cases

Ample practice, starting with simple field shapes, together with some knowledge of the typical shapes of commoner types of fields, is essential for the solution of field problems with a useful speed and accuracy. The construction of some common basic fields has been given in the textbooks[6] and will be only briefly mentioned here.

Fig. 3 shows an exterior 90° corner and it should be noted that the field is symmetrical about the flux line OB and about the construction line OC which bisects the angle AOB. Fig. 4 shows the form of the field at an interior 90° corner and again there is symmetry about a flux line OB and a construction line OC.

The field of Fig. 5 is typical of a deep slot in an armature or the field between deep conductors of equal potential. The field becomes very weak as it penetrates into the slot, and repeated subdivision of the curvilinear squares is required to establish that the plot is correct. There is a flux line symmetry OA and a construction symmetry OB for parts of the slot away from the top and the bottom.

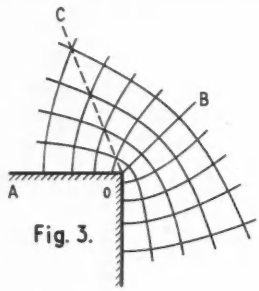


Fig. 3.

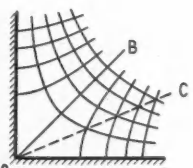


Fig. 4.

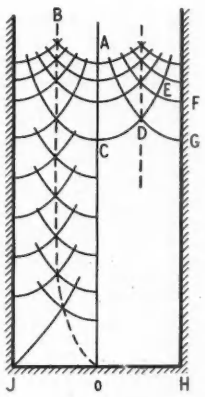


Fig. 5.

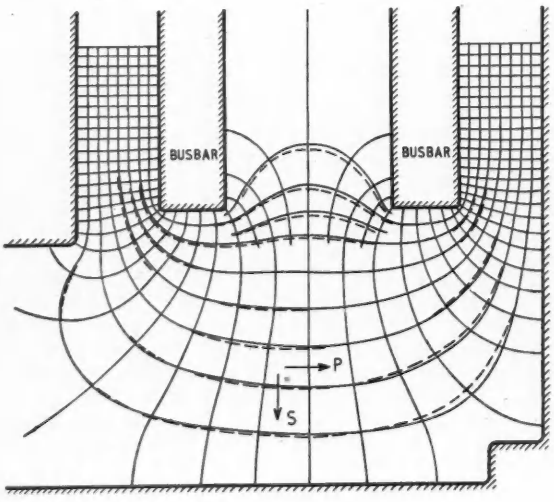


Fig. 6.

The small curvilinear square DEFG has the same capacitance as the curvilinear square OCDGH, but further sub-division, as on the left-hand side of Fig. 5, is necessary to show that this area is indeed a curvilinear square.

At O in Fig. 4 and at J in Fig. 5 a singular point occurs. This is a point or line in the field where the electric field strength is zero, and the intersection of flux lines and equipotential lines is not at 90°. Singular points will also be recognised in Figs. 11 and 12.

Two-Dimensional Single-Dielectric Fields

Fig. 6 shows the lower half of the field due to two rectangular busbars, in a busbar chamber when both busbars are at the same potential. The field between the conductors is similar to that of the deep slot shown in Fig. 5.

Since the capacitance of all the main curvilinear squares is the same, it is clear that the total capacitance C is proportional to P/S where P = no. of curvilinear squares along any equipotential line, i.e., no. in parallel, and S = no. of curvilinear squares along any flux line, i.e., no. in series. For a 1 cm. depth of field in a dielectric of permittivity κ, the capacitance becomes

$$C = \frac{\kappa P}{4\pi S}\,\frac{10}{9}\,\mu\mu F.$$

The plot is actually one of a series of field plots made several years ago to determine the thermal resistance of compound filled busbar chamber arrangements. The plot shown is of adequate accuracy for determining the thermal resistance, but an attempt to carry out further sub-division of the weak field between the busbars would show some small errors, as the curvilinear squares cannot be formed here. A recent plot of this arrangement, made with an electrolytic tank, shows that the effect of this on the main part of the field is quite small, and the electrolytic tank results are shown dotted on Fig. 6 for comparison.

If a field arrangement has additional electrodes at known fixed potentials the equipotential lines of corresponding voltage must terminate on them, but otherwise the field is plotted in the usual way. If an additional electrode is not separately supplied, but takes an unknown potential according to its position in the field, a value must first be assumed and the field tentatively drawn. As the net charge is zero the flux entering the electrode must equal the flux leaving it, therefore the number of flux tubes entering the electrode must equal the number leaving it. The space bounded by adjacent flux lines is called a flux tube. Trial solutions must be made until this condition is satisfied, as well as the condition of curvilinear squares.

Two-Dimensional Multi-Dielectric Fields

At a boundary where the permittivity of a dielectric changes from κ_1 to κ_2, there is refraction of the flux lines and equipotential lines, and the capacitance of the curvilinear squares in the changed dielectric would suddenly change in proportion to the permittivity. As we wish to keep the capacitance of each element the same, the length to width ratio must be changed in the changed dielectric and the curvilinear squares become curvilinear rectangles.

For unit depth of the field where L is the mean length between equipotential lines, and W the mean width between flux lines, the capacitance of any curvilinear rectangle is proportional to $W\kappa/L$. If in the dielectric of permittivity κ_1 curvilinear squares have been drawn, i.e., $W/L = 1$, in the dielectric of permittivity κ_2 curvilinear rectangles must be drawn with $W/L = \kappa_1/\kappa_2$.

At the dielectric boundary the tangential components of the field strength E_t and the normal components of flux density D_n are continuous. The normal components of field strength E_n and the tangential components of flux

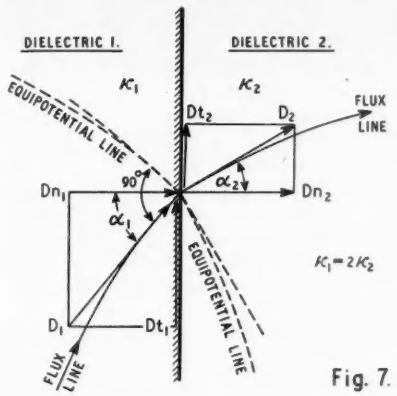


Fig. 7.

$$\frac{\tan\alpha_1}{\tan\alpha_2} = \frac{\frac{Dt_1}{Dn_1}}{\frac{Dt_2}{Dn_2}} = \frac{Dt_1}{Dt_2} = \frac{K_1 Et_1}{K_2 Et_2} = \frac{K_1}{K_2}$$

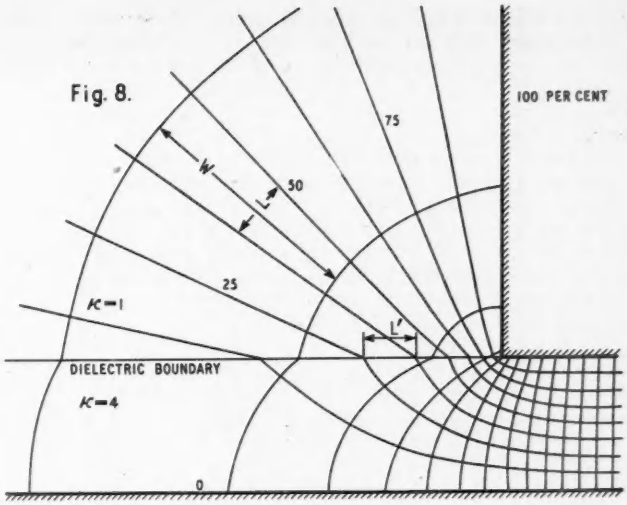


Fig. 8.

density D_t are discontinuous. Remembering that $D = \kappa E$ we can write:—

$$D_{n_1} = D_{n_2} \qquad E_{t_1} = E_{t_2}$$

$$D_{t_1} = D_{t_2}\frac{\kappa_1}{\kappa_2} \qquad E_{n_1} = E_{n_2}\frac{\kappa_1}{\kappa_2}$$

The refraction of the flux lines is shown in Fig. 7 and from the figure the usual tangent law of refraction can be deduced:—

$$\frac{\tan\alpha_1}{\tan\alpha_2} = \frac{\kappa_1}{\kappa_2}$$

When constructing a plot it is not convenient to measure angles and the refraction is best obtained by setting off equal normal components and tangential components proportional to κ, at the point of intersection of the flux density line with the dielectric boundary, in the manner shown in Fig. 7. The equipotential line tangents are constructed at 90° to the flux line tangents, or if more convenient, they can be constructed in a similar way to the flux lines.

When plotting multi-dielectric fields, the whole area should be sketched out into coarse curvilinear rectangles, noting that flux lines entering material of high permittivity are always bent towards the surface and equipotential lines are bent away from the surface. The approximate ratio of L to W for the coarse curvilinear rectangles that cross the boundary may be estimated by comparing the relative amounts of the two dielectrics included.

Fig. 8 shows the field at the edge of an electrode adjacent to an insulation surface, and the refraction of the flux and equipotential lines and the change in the L to W ratio are clearly seen.

Axially Symmetric Fields

An important range of three-dimensional fields having axial symmetry, are, in principle, capable of solution, although in practice the work involved is rarely justified.

An element ABCD of such a field is shown in Fig. 9 and since the depth of the tube formed by rotating ABCD round the axis is $2\pi R$, the capacitance of the element is proportional to $R\kappa W/L$. Thus, for all curvilinear rectangles to have the same capacitance the ratio of W/L varies inversely with the distances from the axis, as well as changing suddenly if the permittivity changes. Since all curvilinear rectangles have the same capacitance the total capacitance for any plot is

$$C = \frac{2\pi R\kappa}{4\pi}\frac{W}{L}\frac{P}{S}\frac{10}{9}\mu\mu F$$

where R, κ and W/L are all taken at the same part of the field and the dimensions are in centimetres. This simplifies to

$$C = \frac{R\kappa}{2}\frac{P}{S}\frac{10}{9}\mu\mu F$$

when R and κ are taken where the 1 : 1 ratio applies.

Fig. 10 shows the field of a conductor passing through a hole in an earthed plate. To assist in making the plot, the ratio of L/W is marked off on the drawing before starting, the position of the 1 to 1 ratio being chosen at any convenient place. Compared with a two-dimensional field between similar electrodes, the equipotential lines are crowded towards the centre conductor.

Examples of more complicated multi-dielectric plots have been given by K. Kuhlmann[7] who shows the field distribution for bushing insulators, but it might be noted that such plots are extremely difficult and tedious to construct, and the resulting accuracy for electric stress calculations is doubtful.

Magnetostatic Fields

The magnetic field in air can be mapped into curvilinear rectangles or curvilinear squares formed by magnetic equipotential or m.m.f. lines, and flux lines, so that all elements have the same reluctance or permeance.

At an iron boundary the tangential components of field strength H_t are equal, and the normal components of flux density B_n are equal. From the tangent law

$$\frac{\tan\alpha_1}{\tan\alpha_2} = \frac{\mu_1}{\mu_2}$$

it is obvious that for permeabilities of iron, μ_1, of the usual order (1,000 or more) the angle α_2 is very small, even for large angles α_1. These refraction laws are, of course, analogous to those for dielectric flux and Fig. 7 may be referred to with appropriate change of symbols. Thus the iron surface may be assumed to be an equipotential surface and the flux lines enter normally.

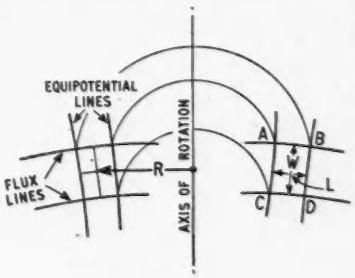


Fig. 9.

If the air field having an L/W ratio

of one is continued into the iron, the ratio L/W becomes extremely large, and the flux lines from the air side which meet the iron boundary practically normally, are refracted through very nearly 90°. Thus in this case the iron boundary cannot be considered to be an equipotential surface from the iron side.

Field distributions embracing both the air and iron spaces would be difficult to plot because of this great change in curvilinear rectangle side ratio, but such solutions are rarely necessary, as either the field in the air only or the field in the iron only, is sufficient in practice. Of course, for the rather unusual case of very low iron permeability, the complete field can be plotted in the same way as a two-dielectric field.

For a field in the iron alone it can usually be assumed that the iron surface is an equipotential line, and the field plotted in curvilinear squares in the usual way. As an example, Fig. 11 shows the effect of a large hole on the flux distribution in a transformer core plate. The variation in the flux density and m.m.f. distribution due to the hole (larger than would be used in practice) can be seen. Unfortunately, in many practical cases, laminations work in the region of the knee of the BH curve, and the permeability cannot be assumed constant as was done for this plot. Inspection of typical curves for steel laminations will show that the permeability changes appreciably for small changes in flux density. Thus the L/W ratio of the curvilinear rectangles would have to be changed by trial and error, starting from a plot assuming uniform μ, until the L/W ratio is correct, i.e., $L/W\mu$ = constant, throughout the plot. A method of constructing such a plot has been described.[8]

Magnetic Fields in Current Carrying Regions

Inside non-magnetic current carrying regions any closed path will contain current and the value will depend on the path described. The solution to the field is a solution of the Poisson equation $\frac{\partial^2 R}{\partial x^2} + \frac{\partial^2 R}{\partial y^2} = -4\pi i$ and the rules given previously for the Laplace equation no longer apply. In the above equation R is the vector potential and i is the current density. Lines of equal magnetic vector potential will give the configuration of the magnetic flux lines.

Rules for graphical plotting have been developed and applied quite extensively.[1, 9, 10] Referring to Fig. 12, these rules can be summarised as follows.

(1) Lines of magnetic equipotential in the air region terminate on the conductor surface but they can be extended into the current region as lines of no work.

(2) Lines of no work meet at a point in the current region called the "kernel," where the magnetic field strength is zero.

(3) Lines of no work divide the current region into equal areas, if uniform current distribution is assumed.

(4) Flux lines continue into the current region and cross lines of no work at right angles. All flux tubes enclose the same amount of flux throughout the field.

(5) There is no refraction of equipotential lines or flux lines, assuming non-magnetic conductors, but there may be a change of curvature.

(6) For curvilinear squares in air, i.e., W/L = 1, the ratio in the current region is greater than 1 and depends upon the amount of current enclosed by the flux tube.

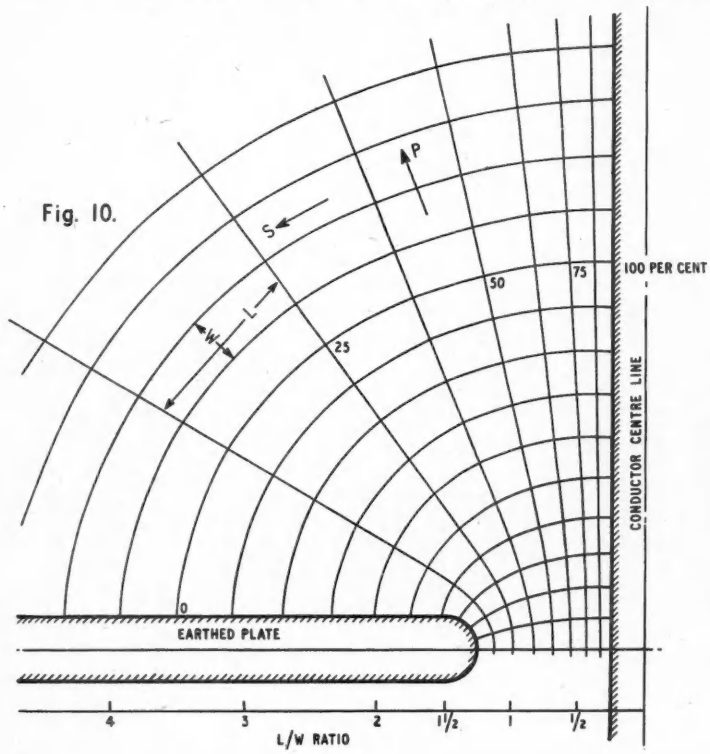
$$\frac{W}{L} = \frac{\text{Total conductor area enclosed by adjacent lines of no work}}{\text{Area enclosed by lines of no work from kernel up to the mean flux line}}$$

The main difficulty is the location of the kernel which can only be done by trial and error. It is, of course, in the middle of an isolated conductor, but for a conductor near iron it is drawn towards the iron and it is drawn towards like currents and moved away from unlike currents.

Fig. 12 shows the two-dimensional field of a circular conductor near an iron plate. The current distribution is assumed to be uniform and the permeability of the iron infinity. It can be seen that the kernel is moved from the conductor centre towards the iron, and the curvilinear squares in air become curvilinear rectangles in the conductor. The equipotential lines projected into the conductor divide the current, i.e., the area, up into equal parts. The change in the ratio of width to length of the curvilinear rectangles can be seen, and, for example, the ratio of the curvilinear rectangle marked A is the same as the ratio of the total hatched area to the cross hatched area.

For a.c. there is a crowding of current and flux towards the outside of the conductor. For 50 c/s the "penetration depth" of the current, in copper conductors, is about $\frac{3}{8}$in and becomes very small for higher frequencies. This low frequency non-uniform current distribution can be approximately allowed for by starting the field plot with a flux line drawn at a suitable distance below the conductor surface. At high frequency, the conductor surface can be taken as a flux line and there will be negligible internal flux.

Fig. 10.



Use of Field Plots

For the two-dimensional electrostatic case the capacitance C per cm depth of field is given by

$$C = \frac{\kappa}{4\pi} \frac{P}{S} \frac{W}{L} \frac{10}{9} \mu\mu F$$

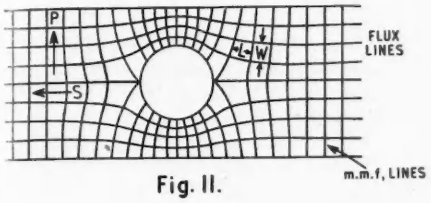
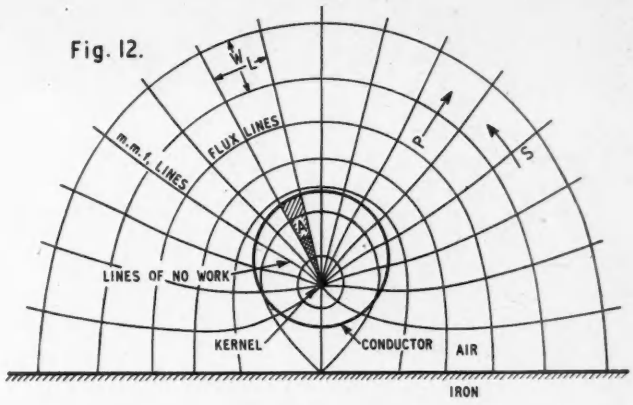


Fig. 11.

Fig. 12.



Considering Fig. 6 as an example, W/L = 1, S = 8 and P = 51; therefore assuming a compound filled chamber, compound permittivity $\kappa = 2{\cdot}6$, the capacitance is

$$C = \frac{2{\cdot}6}{4\pi}\frac{51}{8}\frac{10}{9}\ \mu\mu F \text{ per cm length}$$

$$= 1{\cdot}47\ \mu\mu F \text{ per cm length.}$$

The field strength or gradient E along any flux line is obtained from V/L where L is the spacing between equipotential lines having a voltage difference V, and places of high stress are obvious from inspection of any particular plot. In practice, the stress is usually changing fairly rapidly at places of interest, and it is necessary to plot stress against distance in the vicinity of such places and draw in a smooth curve. The curve can be extrapolated to the conductor surface to find the maximum stress.

Where an insulation boundary occurs as in Fig. 8, the tangential stress along the surface of the insulation is of interest. It follows from Fig. 7 that the resultant stress, found as described, can be separated into the normal and tangential components at any surface of interest. However, in practice, it is easier to calculate the tangential stress from the spacing L′ of the equipotential lines where they cross the insulation boundary.

By analogy with the calculation of capacitance, the thermal resistance R_θ, using practical units, is easily found from a field plot.

$$R_\theta = \frac{S}{P}\frac{L}{W}\frac{1}{\lambda}\ ^\circ C/\text{watt per inch length}$$

where λ = thermal conductivity in watt/inch °C. The temperature drop θ through the medium is therefore

$$\theta = P' R_\theta\ ^\circ C$$

where P′ = power generated per inch length in watt/inch.

Considering the busbar chamber Fig. 6 as an example, and taking the thermal conductivity of compound as 0·004 watt/inch °C, the thermal resistance of the part shown is

$$R_\theta = \frac{8}{51 \times 0{\cdot}004} = 39{\cdot}2\ ^\circ C/\text{watt per inch length.}$$

For thermal plots the equipotential lines become isothermal lines and, if the field includes materials of different thermal conductivities, there is refraction at the boundary according to the rules given in Fig. 7 with λ substituted for κ.

The application of a plot to current conduction problems is straightforward, κ being replaced by electric conductivity or $1/\rho$ where ρ is the resistivity. For example, Fig. 11 could represent a bolt hole in a busbar; the flux lines become current flow lines and the m.m.f. lines become equipotential lines. The resistance of the part shown is

$$R = \frac{S}{P}\rho \text{ ohms per inch thickness of bar}$$

where ρ = electrical resistivity, ohm inch.

For magnetic fields, outside the current carrying region, the reluctance R_m per unit depth is given by

$$R_m = \frac{S}{P}\frac{1}{\mu}\frac{L}{W}$$

where P is the number of curvilinear squares along any m.m.f. line and S is the number along any flux line. Using centimetre units, the relation

$$R_m = \frac{\text{m.m.f.}}{\Phi} = \frac{4\pi\ NI}{10\ \Phi}$$

enables the ampere-turns, NI, or the flux, Φ lines, to be found as required.

Referring, for example, to Fig. 11 and considering a 1 cm depth, the magnetic field strength H at any part is given by

$$H = \frac{\text{m.m.f.}}{\text{length of path}} = \frac{4\pi}{10}\frac{NI}{SL} \text{ amp turns/cm.}$$

The flux density B at any part is

$$B = \frac{\Phi}{PW} \text{ lines/cm}^2$$

If the flux Φ links N turns each carrying I amp the inductance L* can be obtained from

$$L^* = \frac{N\Phi}{I} = \frac{N}{I}\frac{\text{m.m.f.}}{R_m}$$

$$= \frac{4\pi}{10}N^2\frac{P}{S}\frac{W}{L}\mu\ 10^{-8} \text{ henry.}$$

This does not include the contribution of any field within the conductors which only links part of the current and thus requires special treatment.

The extension of these equations to fields with axial symmetry will be obvious from the example of the capacitance calculation previously given.

Acknowledgments are made to Ferranti, Ltd., for granting facilities to prepare this article and to Ferguson Pailin, Ltd., for permission to use the material concerning Fig. 6.

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Power Station Trends

THE subject of post-war trends in the design of power station plant was fully dealt with in a paper recently read by Mr. F. J. Hutchinson before the Manchester Association of Engineers. Since the war, he said, the main consideration in the development of large public power stations was the cost which had risen from less than £20 per kW in 1930 to about £60 per kW in 1954. There was now a tendency for it to settle down at £50 per kW, owing to the installation of large blocks of power in one place.

Since 1925 there had been a progressive reduction in the number of boilers connected to one turbine until the "unit" arrangement had been reached. The major reason for this was the general introduction of pulverised fuel firing, other reasons being that more suitable metals had been produced for the onerous conditions which had to be met, the improved design of furnaces and superheaters and the ever-increasing cost of coal.

While the station thermal efficiency had steadily increased during the past thirty years it must be pointed out that a very high thermal efficiency combined with low reliability and excessive maintenance was not commercially economic. In fact, the only figure which was of value was that obtained over a year's working with a high availability factor. The maximum efficiency to date in this country was 31·46 per cent with an availability of 88 per cent. This had been achieved at the Portobello station, near Edinburgh. In America the figure of 34·5 per cent had been reached at the Kyger Creek station.

Boiler Design

The boilers themselves had undergone a dramatic change in structure, rating and size. For reasons of economy they were now integrated with the boiler house steel work and were suspended from the roof. Units now under construction in this country had ratings of 540,000, 860,000 and 1,350,000 lb per hour; and it was believed that outputs up to, say, 2,200,000 lb per hour were being investigated. The advent of pulverised fuel and the radiant heat which was thereby made available not only for the steam generating tubes, but for some portions of the superheater, had led to a great increase in the height of the furnace and the replacement of the wide, squat shape by a slim elegant structure.

Chain-grate stoker-fired boilers were satisfactory up to outputs of 150,000 to 200,000 lb per hour, while the "spreader" stoker could be operated successfully on boilers up to 250,000 lb capacity. For larger units the cyclone design had been developed in addition to pulverised fuel firing; it was particularly successful for burning coal with an ash fusion temperature of about 2,200 deg F or less. It was impossible for slag-tap furnaces to make such headway in Great Britain as the ash fusion temperature of the coal was an important factor in their employment and British stations had to take anything that might be delivered. Pressurised furnaces, which were entirely under the influence of the forced draught fans, had not been developed in this country, although it was claimed that they were 0·5 per cent more efficient than the more conventional types. Practically all large modern boilers were associated with reheat turbines and their design had been modified accordingly.

The major problems in connection with steam pipes was metallurgical, and at temperatures above 1,050 deg F it was necessary to use austenitic steel. In turbines the continuous maintenance of very small clearances between the fixed and moving blades was necessary. Manufacturers had therefore been providing high-pressure high-temperature forgings of chrome-molybdenum steel. This might be replaced by austenitic steel as the steam pressure and temperature were further increased. The difficulty experienced in the welding of austenitic steel had been overcome by performing the operation in an atmosphere of helium on the outside and of argon on the inside of the tube, respectively.

The supply of steam to the high-pressure and low-pressure feed water heaters from appropriate stages of the turbine ensured that only sufficient steam reached the exhaust to enable the heavy losses to be economically justified. These feed water heaters, however, considerably complicated the feeding arrangements. In this country for 120 MW sets low-pressure pumps were used to deliver the feed through the water heads of the high-pressure heaters to the suctions of the boiler feed pumps. In America, however, the large majority of the feed pumps were in one unit and delivered the water through the heads of the high-pressure heaters to the boilers.

At the alternator end the greatest change to date had been hydrogen cooling which, with a gas pressure of 15 lb/sq in, enabled an increase in output of 19 per cent to be obtained against a standard temperature rise of 50 deg C. The cooling of the copper bars in the stator and rotor slots had been the subject of considerable experimentation; and the latest designs employed hollow bars through which hydrogen was forced, thereby removing the heat by direct contact. At least one manufacturer had produced an alternator in which the stator bars were cooled by distilled water which was forced through their longitudinal centres.

BOOKS RECEIVED

Power System Stability. Vol. III—Synchronous Machines. By E. W. Kimbark. Pp. 322; figs. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 80s.

National Coal Board. The First Ten Years. Edited by Sir Guy Nott-Bower, K.B.E., C.B., and R. H. Walkerdine, B.Sc., Assoc.M.I.Min.E. Pp. 256; figs. The Colliery Guardian Co., Ltd., 30-31, Furnival Street, Holborn, London, E.C.4. Price 21s.

Planned Artificial Lighting. By John W. T. Walsh, O.B.E., M.A., D.Sc., M.I.E.E. Pp. 192; figs. Odhams Press, Ltd., 96, Long Acre, London, W.C.2. Price 25s.

Drawing Office Handbook. 3rd Edition. Edited by R. W. Stuart Mitchell, M.Sc., A.M.I.C.E., M.I.Mech.E. Pp. 424; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 16s.

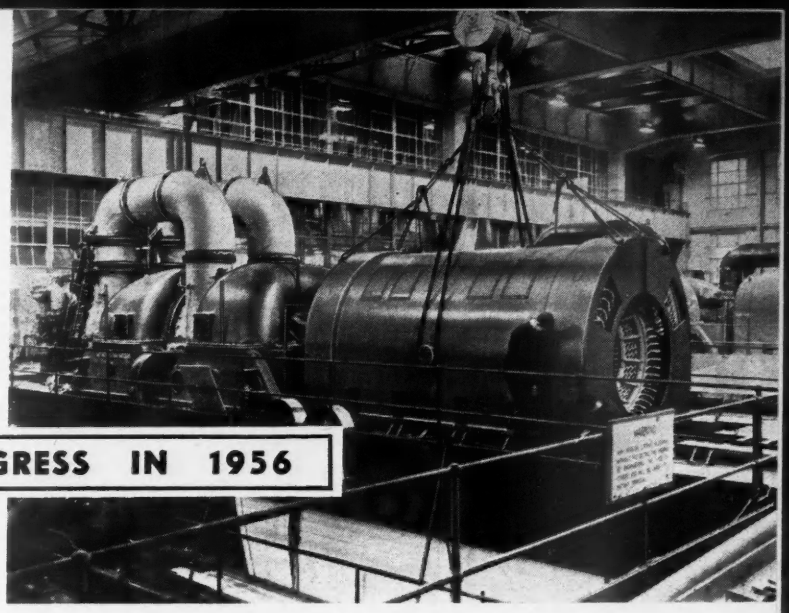
Digital Calculating Machines. By G. A. Montgomerie, B.Sc., A.M.I.E.E., A.M.I.Mech.E., Assoc.I.R.E. Pp. 262; figs. Blackie & Son, Ltd., 17, Stanhope Street, Glasgow, C.4. Price 30s.

Improve Your TV Reception. By John Cura and Leonard Stanley. Pp. 112; figs. Published for *Wireless World* by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 5s.

"Mechanical World" Electrical Year Book 1957. Pp. 361. Emmott & Co., Ltd., 31, King Street West, Manchester, 3. Price 3s 6d.

"Mechanical World" Year Book 1957. Pp. 254. Emmott & Co. Price 4s 6d.

Metropolitan-Vickers Electrical Co., Ltd.



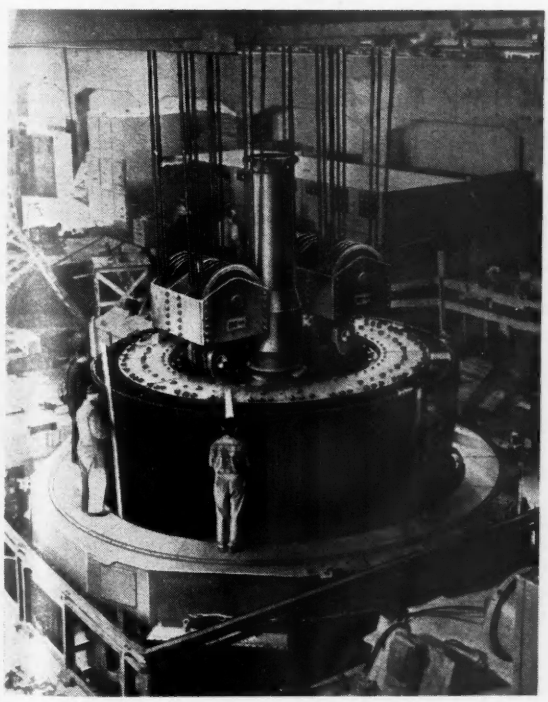
MANUFACTURING PROGRESS IN 1956

This 30 MW turbo-alternator in Bold power station has direct water-cooled stator windings

DURING 1956 the Metropolitan-Vickers Electrical Co., Ltd., put into service thirty-three steam turbo-generators with an aggregate capacity of 725 MW. Seven of these machines with a total capacity of 430 MW were commissioned for the Central Electricity Authority. Among these was the first of six 100 MW sets for Castle Donington power station, the second 60 MW machine at Portishead "B," and similar sets at Carrington and Chadderton.

All these have turbines of the latest close-coupled design driving hydrogen-cooled generators. A 30 MW set at Bold power station, St. Helens, represents an important advance in generator design, the stator windings being water cooled; it is believed to be the only machine of this type in service, either at home or abroad. All the 100 MW and 60 MW sets were supplied complete with condensing plant and feed-water heaters. In overseas power stations twenty-three turbo-generators were commissioned. The largest of these was the first 66 MW 3,600 r.p.m. set at Wabamun in Canada.

Erecting one of four 138 MW 18 kW waterwheel generators at Bersimis, Canada



Orders for main generating plant have been received from the C.E.A. and from distant parts of the world. Ten turbo-generators with an aggregate capacity of 750 MW are required for home power stations. These include several 120 MW machines—three for Staythorpe, a second for Agecroft, and a fourth for Blyth, all incorporating reheat turbines driving hydrogen-cooled generators.

The company is to supply the main generating plant for the nuclear power station of the C.E.A., which is to be built by an associated company (A.E.I.-John Thompson Nuclear Energy Co.) at Berkeley in Gloucestershire. It will be equipped with four turbo-generators, each having a mixed-pressure tandem compound turbine driving an 80 MW generator, with condensing plant and l.p. feed heating equipment.

Overseas Orders for Generators

Twenty-seven turbo-generators have been ordered by countries outside Great Britain, one of these being for installation in Canada's first nuclear power station. This plant, which is to be installed by the Ontario Hydro-Electric Power Commission at Des Joachims, consists of a single-cylinder 20 MW turbine operating on dry saturated steam at 400 lb/sq in and driving an air-cooled 60 c/s generator at 3,600 r.p.m., and will be supplied complete with condensing plant and three-stage feed-water heating equipment.

Waterwheel generators in the largest sizes, mostly vertical machines, have been completed and dispatched to hydro-electric stations overseas. They include the fourth 75 MVA 214 r.p.m. generator for the San Esteban station of Saltos Del Sil, which was opened by General Franco in September and is the largest in Spain. Two further 138 MW 277 r.p.m. generators have been shipped to Bersimis, Quebec, and three of the four machines at this station will shortly be put into service.

Synchronous condensers rated at 20 MVA, 1,000 r.p.m. have been completed for Rosherville substation, South Africa, and for the central switching station at Kitwe, Northern Rhodesia. Another synchronous condenser

completed is a 30 MVA, 1,000 r.p.m. machine for the Melancolicos substation of Hidroelectrica Espanola, which has an even larger unit on order. This is a 50 MVA, 1,000 r.p.m. machine for Torrente substation; it is designed for erection without the use of a heavy crane and is for outdoor operation.

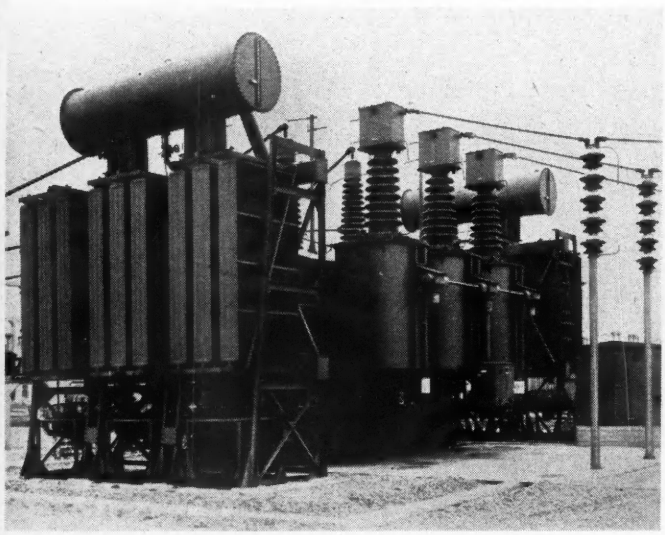
Transformer Production

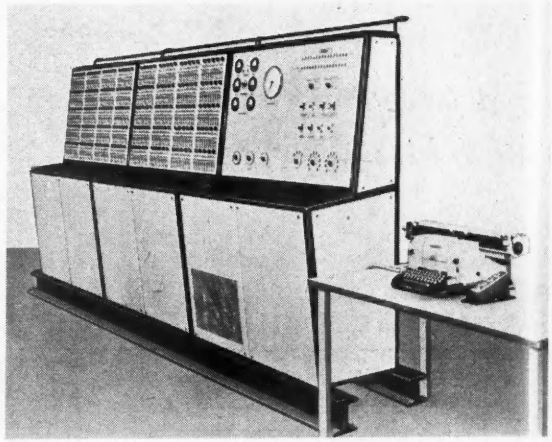
The new transformer factory at Wythenshawe has been completed and is expected to be in full operation in 1957; the transfer is being carried out without interrupting output. Generator transformers built for the C.E.A. during the year included the first of three 106 MVA 13·8/295 kV units. The high-voltage winding has graded insulation, suitable for operating with the system neutral earthed, and is connected to an on-load tap-changer enabling the voltage to be varied over a range of ±10 per cent in eighteen steps; this is the largest metalclad tap-changer built so far. The third 120 MVA 13·8/141·6 kV transformer, also with on-load tap-changing equipment, has been dispatched to Castle Donington, and a number of 36 and 72 MVA units (together with station auxiliary and unit transformers) have gone to various Generating Divisions of the C.E.A.

Improvements have taken place in the design of transformer tanks, and an experimental unit incorporates round tubes, swaged at each end and welded into headers that in turn are welded into the tank; this enables a very large tube surface to be accommodated and may provide a useful solution to cooling problems lying between the normal cooling tube arrangement and the more elaborate radiator layout. Many problems continue to be investigated with the help of the electrolytic tank constructed some years ago. This has been modernised and partly rebuilt so that three-dimensional studies can now be made.

A further step in the transmission and switching of high voltages is marked by two orders received from Australia for the Snowy Mountains hydro-electric scheme. They cover the supply of nine three-phase and one single-phase 330 kV outdoor air-blast circuit-breakers. Other orders for air-blast breakers involve 230 kV and 300 kV units for Canada and 220 kV units for Spain. Type tests on the 230 kV 15,000 MVA (U.S. rating) air-blast circuit-breakers for the Ontario Hydro-Electric Power Commission have been completed, and the first breakers on this order are now installed. Air-blast breakers for 275 kV and 132 kV service have been ordered by the C.E.A., these including nine 132 kV breakers for indoor use at Uskmouth power station. The South of Scotland Electricity Board has ordered thirteen 132 kV 3,500 MVA breakers for Kincardine.

132/275 kV auto-transformer with on-load tap changer at Castle Donington





Sunvic analogue computer for the Admiralty

Testing of the LG range of oil circuit-breakers is almost complete, and A.S.T.A. certificates have been issued for several ratings. Substantial orders have been received from South Africa for 88, 66 and 44 kV oil circuit-breakers, and from Greece, against fierce German competition, for 750 MVA 22 kV breakers.

Industrial Equipment

Work undertaken for industrial and commercial undertakings includes turbo-generator sets, rectifiers, transformers and switchgear for works power and distribution systems, together with a variety of equipment for electric drives, welding, heating, testing and other applications. Much of this is supplied in the course of comprehensive contracts, which during the past year have ranged from the electrical equipment of a large rolling mill or mine winder to the complete electrification of a cement works, paper mill, or pumping station.

The largest motors in hand include machines of 34,000 and 10,000 h.p., which are out of the normal run, together with many in the 1,000 to 6,000 h.p. range, chiefly for steelworks and mines. Motors for medium and smaller drives, and for the specialised machinery employed in such industries as cement, metal, mining, oil, paper and textiles and in docks, waterworks and drainage schemes have been supplied. The advantages of electronic control are now well appreciated, and magnetic amplifiers of the flux-resetting type, an M-V development, are finding many applications owing to their inherent simplicity and quick response.

Equipment made for various industrial processes includes arc, resistance, and other welders; induction, dielectric, resistance and infra-red heaters; and X-ray generators for radiography and diffraction. Substantial numbers of magnetic crack detectors are being supplied, as well as large amounts of special materials such as the non-linear resistance "Metrosil," "Cutanit" hard metal, and "Elmet" compound metals.

A new general purpose digital computer, the "Metrovick 950," has been introduced and, with other data-handling equipment such as analogue computers, will

facilitate calculations and analyses; machines of this character already have a number of commercial and technical applications.

The company's already large capacity for the manufacture of railway motors and generators is to be doubled by extending its traction motor works at Sheffield at a cost of £2¼ million, and increased capacity is being provided for control equipment. This will enable more export business to be undertaken without prejudice to the substantial assistance available to British Railways in their modernisation plan. Work is at present in hand on electric locomotives, diesel-electric locomotives and multiple-unit trains, all of which are envisaged in this scheme. Much special equipment is being developed for operation on the new 25 kV 50 c/s single-phase a.c. system adopted by the British Transport Commission. Overseas, main line locomotives have been dispatched to Eire, Western Australia and New South Wales, and nearly two hundred will be in service in those countries by the end of 1957.

Many specialised types of apparatus are developed in the company's Research Department and manufactured thereafter for use in outside laboratories. Important examples are the linear accelerator, the mass spectrometer and the electron microscope. Several linear accelerators are on order from the United Kingdom Atomic Energy Authority, including high-energy machines for Harwell and a low-energy type for irradiation work. Early in 1957 the company will be providing its own irradiation service at the Barton Works. Also associated with atomic and nuclear work are some large electromagnets recently made for the U.K.A.E.A., and the heat exchangers, control systems, and instrumentation on order for reactors at several research centres.

FURTHER ELECTRICITY BILL AMENDMENTS

THE Paymaster General, Mr. Reginald Maudling, replied to a brief debate on the motion that Clause 19 should stand part of the Bill when consideration of the Electricity Bill was resumed by a committee of the House of Commons last week. He said the Clause gave the Boards the power, in the first instance, to use their surpluses as they themselves determined, and it was only in the second instance that the Minister was given power to issue directions with the approval of the Treasury. On the question of to what extent these reserves, when earned, should be used to finance the expansion of the business, it was unwise to draw hard and fast rules. There was room for argument on whether or not expansion should be self-financed or financed by recourse to the market. They could not completely apply, without modification, the practice of private enterprise to a public monopoly, and this question was a matter for commercial judgment in any given set of circumstances.

In practice the industry had still quite a long way to go in increasing its profits before it could begin to finance any expansion. Considering the current position of the industry and the importance of maintaining the lowest possible price of the product to the consumer, he suggested that it would be ambitious for the industry to aim at covering the wastage of its assets on a full replacement cost basis and at accumulating a contingency reserve. There were clearly small expansions which might well be financed from internal resources. On the other hand, in current circumstances, the large expansion of the industry could come only out of borrowing from the market.

The Clause was approved.

Former Local Authority Undertakings

On Clause 20 (" Compensation to Local Authorities "), Mr. Maudling moved a series of amendments to ensure that the existing principle, under the 1947 Act, in relation to compensation to local authorities was maintained. He said that this Clause, as drafted, referred only to sums payable by the Central Authority and left out sums payable to them. The amendments would ensure that when the Electricity Council accepted the obligations of the C.E.A. in the way of debits, it would also inherit the credits.

The amendment was agreed to.

Mr. Maudling moved an amendment to centralise liability to all local authorities primarily in the Electricity Council. He said the question posed was one of allocating responsibility in respect of former local authority undertakings between the various Boards, under the new arrangements. It had been pointed out to them by the C.E.A. that the Bill as now drafted might lead to some very complicated and awkward negotiations.

The amendment was agreed to, and the Clause was approved.

British Electricity Stock

On Clause 21 (" Transfer of Assets and Liabilities of Central Authority "), Mr. Maudling moved an amendment to transfer all liabilities and obligations of the Central Authority in respect of British Electricity stock, before vesting date, to the Electricity Council. He said that under the Clause the Exchequer advances were made the responsibility of the Electricity Council, but nothing was said in the Clause about the responsibility for electricity stock already in issue before the vesting date. The Council would have power under Clause 15 (3, *a*) to obtain from the Boards the finances which it required to meet its obligations under the Clause.

The amendment was agreed to, and the Clause was approved.

On Clause 22 (" Supplementary Provisions as to Transfer of Assets and Liabilities "), Mr. Maudling moved an amendment to ensure that a large obligation in respect of stamp duty was not placed upon the Electricity Council with the exchange of liabilities between it and the C.E.A. He said the sum of capital involved here was £1,166 million and the stamp duty bill, if the Clause were not amended, would be nearly £3 million.

The amendment was agreed to.

On the motion that the Clause should stand part of the Bill, Mr. Palmer said that there had been a certain process of loan and exchange of employees between the C.E.A. and the Atomic Energy Authority. Many of these employees, who were, in the main, staff engineers, probably hoped later to return to the electricity supply industry. Some had letters or oral understandings that they would be able to do so. In addition, there were instances of employees who had gone overseas, by an understanding with the C.E.A., to assist foreign, Dominion or colonial electricity undertakings. It was important for

these people to know which of the new authorities would take responsibilities for the understanding arrived at with the C.E.A. or with the Area Boards. There were instances also in the industry of payments being made to widows and dependants by the Boards. They were very informal understandings, but at the same time definite obligations and the dependants were anxious to know whether the Council, the Generating Board or the Area Boards would observe these understandings.

Mr. Maudling said that subsection (1) transferred to the appropriate transferee the rights and obligations arising under existing agreements. He could confirm that this would apply whether the agreements were in writing or not. Subsection (7) of the current Clause defined what were appropriate transferees. He gave an undertaking to examine the subsection to make sure that the wording was wide enough.

The Clause was approved.

On Clause 23 (" Compensation to Members and Officers of Central Authority "), Mr. Wells moved an amendment to extend the compensation provisions of the Bill to include officers and members of the Area Boards who might be displaced in consequence of the passing of the Bill. Taking the precedent of an earlier Clause, he said, the Opposition considered that there should be a central fund to provide for this compensation equally for members and officers of the Area Boards.

Mr. Maudling said the Bill as drafted did not contain any reference to employees of Area Boards because it was not thought that there would be any likelihood of people working for the Area Boards being in any way harmed, but he saw no reason why rights given to people under the Central Authority should not be extended, as suggested. If Mr. Wells would withdraw his amendment he would undertake to move a Government amendment on report to produce the effect that Mr. Wells had in mind.

The amendment was, by leave, withdrawn.

Appeals Against Compensation Awards

Mr. Wells moved an amendment to provide a more adequate appeal procedure where claimants to compensation might be dissatisfied with the amounts awarded, or with the rejection of their claims. He said that the wording of the principal Act, which laid down the procedure for obtaining compensation, might be construed to mean that in these appeals the decisions of the referees or board of referees should be final.

Mr. Maudling undertook to put down a Government amendment on report dealing with the right of appeal to the High Court and the amendment was, by leave, withdrawn.

On the motion that the Clause should stand part of the Bill, Mr. Palmer said it was their understanding of the Bill that compensation would not only be for salaried staff, but, in many circumstances, would also be available to the manual worker who was an established servant of a Board. Mr. Maudling said that as he understood it, " servant " meant someone who served the undertaking in whatever capacity, manual worker, industrial worker, or anyone else.

The Clause was approved.

Meter Certification

On Clause 24 (" Certification of Meters "), Mr. Renton, Parliamentary Secretary, Ministry of Power, announced that it was hoped that by 30th June, 1958, all the meters in this country would have been tested and either certified or rejected. All meters installed since 1936 had been certified by a process known as batch testing, the reason for this being that there were some 400,000 new domestic electricity consumers in the year 1955-56 and there were now nearly 15 million consumers over the country as a whole. If they were to abandon altogether the system of batch testing there was no knowing how many of these highly experienced and qualified people they would have to have. On merits the principle was sound, and it would be impossible to have matters otherwise.

The Clause was approved. Clauses 25 to 31 inclusive were also approved.

Disputes Between Boards

Mr. Renton moved a new Clause (" Representations by Electricity Boards to Electricity Council ") which, he said, provided a new formal procedure for settling disputes between Boards. The Clause empowered the Electricity Council to inquire into any representations made to it by one Board about another. There must, however, be consultation first between the Boards concerned. The point of this prior consultation was to avoid any reference to the Electricity Council, if possible, but if prior consultation failed to resolve the dispute then either or both Boards might make representations to the Electricity Council which would hear one or both Boards and consider the matter. Having done so, the Electricity Council might give formal advice to either or both Boards. The advice would take the form of suggestions for remedying any defect which the inquiry disclosed.

If the advice was not accepted the Electricity Council could make representations to the Minister. If the Minister found, after consultation with the Generating Board and with the Area Board or Boards concerned, that there was a defect in any Board's general plans and arrangements for the purpose of its functions, he could give such directions as he thought necessary. The advantages in having this kind of procedure were that it would strengthen the advice which the Electricity Council could give, without interfering too much with the independence of the Boards, and it would provide a simple and workable machinery for settling disputes between Boards. It would also avoid concentration of power at the centre, and keep the Minister clear of the industry's day-to-day business, while placing upon him that final responsibility in important matters which the Minister should bear. Finally, it would have the advantage that with this procedure even questions about the bulk supply tariff could be satisfactorily dealt with.

Mr. Warbey said it appeared that the Minister would be the final court of appeal, but only if the Electricity Council itself decided to make him so. He did not see any provision in this new Clause by which any of the Boards might make representations against the Electricity Council's decisions, actions or the performance of its functions.

Remarking that the procedure envisaged under the new Clause was certainly not simple, Mr. Palmer said that whether it would be workable only time would show. The Boards themselves had a majority on the Electricity Council. Why they could not talk with one another over the table if they had a disagreement he could not understand. The industry feared that the effective power in resolving differences which would from time to time arise, because of the refusal of the Government to give power to the industry itself to resolve these differences, would in fact be left with the Minister, which meant that, though the Government were not anxious to admit it, the Minister or a civil servant would have the authority. This meant more and not less Government control over the industry.

Mr. Renton contended that Opposition members had

made extremely heavy weather of this matter. The Boards, individually, would always have the right of access to the Minister but he emphasised that the Minister had no intention of being drawn into frequent controversies with the Boards by this or any other procedure.

The Clause was approved.

Tax Payments

Mr. Maudling moved a new Clause which, he said, was designed to settle the taxation basis of the industry. As drafted, the Bill would place upon the Generating Board the responsibility for meeting all the taxation liabilities of the industry. Obviously, this was not satisfactory and they had to make up their minds whether the various Boards should be taxed individually or whether the industry should be taxed as a whole. There was something to be said on either side, but on balance it seemed wise to permit the industry to continue to be taxed as a whole, setting off the capital allowances of generation against the revenue earned by the Area Boards. This would follow the public enterprise example of coal and transport, and the private enterprise example of associated companies, and he believed this to be a fair arrangement. Any other arrangement would cause a substantial tax liability to fall on the consumers of electricity.

Mr. Palmer said the Opposition considered this an extremely sensible proposal and it had their full support.

The Clause was approved.

Land Survey Powers

Mr. Maudling moved a new Clause (" Entry on Land for Purposes of Exploration ") to grant the electricity authorities compulsory power to enter land for survey purposes. The reason which lay behind it, he said, was the importance of getting ahead with the nuclear energy programme as quickly as possible. The Government felt they could speed up some procedures involved in the siting and building of generating stations and transmission lines without in any way interfering with the rights of individuals. The electricity authorities already had compulsory powers of acquisition, but they had no compulsory powers of entry for purposes of exploration. Clearly such powers had to be circumscribed for the benefit of the individual. They had looked for a suitable precedent and found one in the Town and Country Planning Act, 1947. Under that Act the right of compensation was given only in respect of damage, but in this Clause the right of compensation was also given for disturbance, which was much wider.

Quite a lot of criticism had arisen because there had been cases of representatives of the electricity authorities going, uninvited, on to people's land. That was a matter of administration and should not arise, and he would be glad to point out to electricity authorities the harm that was done to public relations if this were done. They had no legal right to go on anybody's land without warning, and where voluntary agreement for survey could not be obtained they would have to give 24 hours' notice.

Mr. Hill opposed the 24-hour provision, which he considered was far too short, and was supported in this by Mr. Hobson who contended that a longer time limit or greater safeguards for consultations would not delay by one day the construction of power stations.

Lord Hinchingbrooke declared that unless the Minister could give a more satisfactory explanation of the need to introduce this Clause now, before any debate had been able to take place on the floor of the House of Commons on the atomic energy programme, he would be obliged to vote against it.

Sir Frank Soskice said the Opposition recognised the public interest, as represented by the need to speed up the nuclear power programme, but they were anxious that the private rights of the individual should not be unduly transgressed. On the other hand, he did not feel the Minister had gone too far in this. It was essential that the least possible obstacles should be placed in the way of the development of these massive programmes which they were now considering. Our country, in the race with other countries along the industrial road, must be given full rein, consistent with a reasonable and properly ordered social structure. He thought the Minister himself had had due regard to both needs.

Mr. Maudling, replying to the debate, said that the Clause would in no way extend the power of acquisition, and in no way delegated the existing procedure for obtaining planning consent, nor did it give a general absolution from the law of trespass. He was prepared to consider lengthening the period of 24 hours' notice, but he emphasised that this power would only be used after it had proved impossible to obtain the power of entry voluntarily. He was also prepared to impress upon the electricity authorities that they should, in every case where the owner was readily identifiable, serve him with notice, simultaneously with the occupier. He would discuss with the electricity authorities ways in which, if possible, prior consultation could be made more effective.

Mr. Gerald Nabarro asserted that it was a gross exaggeration to say that the nuclear power programme might be prejudiced if the Minister did not have the powers contained in this Clause. He wanted not only three months' notice, but the right of appeal to an independent tribunal for the aggrieved party.

The new Clause was carried to a division and, supported by Opposition members, it was read a second time by 21 votes to 9. The motion that it be added to the Bill was carried by 22 votes to 8.

Expediting Construction Procedure

Moving a further new Clause (" Expedition of Highway Procedure in Connection with Electricity Works "), Mr. Maudling said it referred only to the generation and not to the transmission of electricity. The development of a new power station or other buildings required for the generation of electricity might make it necessary to stop up highways. The 1947 Act provided that, where planning permission had been given, the Minister of Transport and Civil Aviation could make an order stopping up such highways, or for the diversion of highways, but in making these orders he was compelled to publish certain facts locally and to specify a place where a copy of the draft order and the relevant maps or plans could be inspected during a period of three months within which any person might object to the making of the order. It was proposed to reduce the period to one month.

The Clause was approved.

R.E.C.M.F. Report

IN the course of its report for 1956-57 the Council of the Radio and Electronic Component Manufacturers' Federation says that the radio and electronic industry continued to make good progress. The recession in the domestic receiver section caused by the " credit squeeze " became less pronounced as the year progressed and by the close of the year television sales had regained the record level set up in 1955. In the professional and capital equipment field production again rose substantially and this section is now the largest in the industry. Despite a fall in sales of domestic radio receivers, the industry's exports were 20 per cent higher.

VIEWS on the NEWS

By REFLECTOR

ONE of the problems of occupations where there is a fixed rate of pay is that there is little inducement—apart from personal satisfaction with a job well done—to acquire greater technical knowledge. For example in the electrical contracting industry, where there is a shortage of man-power and consequently no difficulty in getting a job, it might be questioned whether time spent in study is worth while. This problem seems to exist even where there is compulsory registration. The other day I came across an article in the *New Zealand Electrical Journal* under the title "Electricians—More or Less" in which an examiner for the Electricians' Registration Board quoted the following passage from the Board's latest report:—

> "Few candidates, after passing their examination, would appear to do further study, judging from the meagre attendance at more advanced classes, or by the number who sit for the advanced qualifying examination of the Trades Certification Board. We are somewhat concerned about this problem, for although candidates who can pass the practical test and manage to scrape through this examination may (and we emphasise 'may') be competent as tradesmen, it becomes very obvious that they are not competent to act in any higher capacity."

The report goes on to suggest that some modification should be considered so that before being allowed to act as men-in-charge, electricians should be required to pass an examination of a somewhat higher standard. The Registration Board says it is obvious to all those actively associated with the industry that the standard needs to be raised and adds "Until this has been done we cannot expect the public to value highly the benefits of registration, or to give the industry the place it should have in the community."

* * *

Stoppages of supply in the Chailey (Sussex) district were discussed at a recent meeting of the Rural Council. It was said that the district manager of the South Eastern Electricity Board had admitted that the electricity supply was inadequate but said that the Board had no liability in respect of claims for loss. He promised, however, that he would approach the Board about claims for loss of ice cream, "in view of the special circumstances. On hearing this a member of the Council asked (as reported in the *Sussex Express*):—

> "Should only ice-cream people get redress? Refrigerators are sometimes running water, and why should people have to go out and buy candles and get candle-grease all over their mantelpieces and carpets."

* * *

A family of eight at Newton-le-Willows (Lancs) has found that in the last quarter their slot meter has registered £29 worth of gas; in the preceding quarter the amount was about £21. It is said by a gas official that for a house and family of that size the normal bill is between £3 and £4. Neither he nor the family can explain the enormous discrepancy. Judging by a recent similar electrical case I should suggest that they should ascertain whether the street lighting is by gas and, if so, who is paying for it. Readers may remember that in the electrical instance a string of lamps in the street had somehow got connected to the consumer's service.

* * *

The Electrical Trades Union was quick to announce its support of the threatened strike in the shipbuilding industry, but I am glad to see that the Union was most anxious to settle a dispute of some of its members with the B.B.C. A report in the *Daily Worker* says that it was "extremely reluctant to act in any way that would interrupt B.B.C. services to the public." In other words, the public can be deprived of its bread so long as it retains its circuses.

* * *

The magazine of one of the Electricity Boards includes the following question and answer in a "quiz":—

> "How many atomic energy generating stations have already been planned by the Central Electricity Authority?"
>
> "Four, including Calder Hall (already operating), Berkeley, Bradwell and Ayrshire (Scotland)."

There is some misplaced credit here.

* * *

Writing to the *Esher News* a correspondent says:—

> "I hope the local authorities will receive with caution the assertion that to put underground the pylons where they would traverse the commons would cost £1½ million. To a mere layman such a sum should be sufficient to establish a line of pylons the whole length of the country . ."

But think of the excavation costs involved in putting pylons underground!

* * *

Sixty years ago electric passenger vehicles seemed to have a good future but, largely because of their limited radius, they failed to stay the course. One strange example illustrated and described in the *Electrical Review* of 26th March, 1897, was an electric hansom cab, one of twelve put into service in New York. Why this peculiar chariot was ever adapted for electrical operation I cannot imagine. The passengers must have felt a little insecure; instead of riding behind a horse they were exposed at the front of the vehicle, protected merely by the usual half-doors. Because of the horse's absence a pair of rear wheels had to be added. Over these was a battery of 70 Ah capacity which supplied power to a 1·5 h.p. motor geared to each front wheel. Steering was by means of the rear wheels; a long vertical rod terminating in a lever was operated by the cabby who was seated at the usual height behind the passengers. It was stated that the cost of operation was one cent per mile—about a halfpenny in those days.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Electricity for Transport

MAY I make a plea for the extended use of electricity for public transport, both road and rail ?

The present fuel shortage has focused attention on the dependence of this country on imported oil, but prior to the Suez affair there was a noticeable and regrettable tendency towards the " dieselisation " of every form of public transport, even in places where electric trolley-bus overhead lines were already in existence. The Suez crisis has resulted in delaying some of the intended change-overs, but even had the Suez affair never occurred the wisdom of such a change seems extremely dubious. It is a well-known fact that the electric trolley-bus is quieter, smoother, more reliable and more economical than the diesel-engined bus (quite apart from the significance of its using home-produced fuel), and it would seem almost a crime to reduce these services, and a grave error not to extend them where practicable.

As the overhead wire is admittedly the sole drawback of the trolley-bus, it seems strange that more effort has not been devoted towards evolving a satisfactory battery-driven vehicle. Batteries are now being made for aircraft which, for a given capacity, are about half the weight of normal ones, and it is certain that with a little initiative and experiment a very serviceable electric vehicle for city transport could be developed.

Rail transport is an even more hopeful field for the battery vehicle. For some time now battery-driven rail coaches have been successfully operated in Germany, and there seems to be no reason why they should not be equally successful here. The North of Scotland Hydro-Electric Board has done its best to stimulate the interest of the British Transport Commission in the battery electric rail coach, but so far has met with little enthusiasm and less response. This attitude is to be regretted, for in Scotland, in particular, where there is now an abundance of hydro-electric power, the battery rail coach could be of immense advantage on light-traffic lines, where costly overhead work would not be justified.

Rosehall, Banffshire. S. G. LAIDLAW.

Inefficient Shop Window Lighting

I WOULD like to call your attention to a very undesirable feature which is lately becoming increasingly common in the field of shop window lighting. This is the practice of fitting mains voltage fluorescent tubes down each side of the windows, close inside the glass. I was able to count over 30 such examples in the course of a short bus ride in London.

If any such installations are the work of contractors, it seems a pity that they should thus advertise their complete unfamiliarity with the elementary rules of window lighting, which I believe are: that the maximum amount of the light provided should be directed on to the goods and not out into the street, and that the source of the lighting should not be visible.

If, as is more likely, this sort of job is the work of amateurs or handymen, then the Press can do good service by letting the " Do it Yourself " section know that this is about the most inefficient use of the fluorescent tube that it is possible to contrive and that the flooding of the pavement outside with a lot of expensive lighting became obsolete over 30 years ago.

One might perhaps also mention the uncomfortably dazzling effect to passing drivers, but nobody loves them anyway !

Muswell Hill, N.10. J. H. ROBBERDS.

Power Factor Correction

REFERRING to Mr. Parkin's comments in your issue of 8th March, the figure of 85 per cent of the magnetising kVA is, of course, laid down in British Standard Code of Practice on Installation and Maintenance of Electrical Machines, Capacitors and Associated Equipment, C.P. 321, 102 (1950).

Within the range of ratings tabulated manufacturers' values of magnetising kVA agree fairly closely, but above 50 h.p. the variation is so great that it is very difficult to give even " typical " values. I therefore considered it unwise to quote figures which could be misleading in my article in the *Electrical Review* of 15th February.

Rugby. H. K. HADLEY.

Early Telephone Licence

I WAS very interested to read " Reflector's " note in the 15th March issue on the telephone of eighty years ago.

As you must have a large number of readers who are telephone engineers they may like to know that when telephones were introduced to this country in 1878 licences to use were issued to the purchasers. In the early 1920's I happened to have in my possession the only licence known to be in existence. This was issued to a Mr. James Davis, of Bradford, in February, 1878, and was for two telephones, the price being £23 less 15 per cent and it gave him the right to use them for lecturing and exhibiting purposes in the counties of York and Durham and in no other place and for no other purpose except by further approval. This licence was No. 64.

Finding out that this particular document was the only one known to be in existence I offered it to the Institution of Electrical Engineers for their museum. The offer was accepted and interested readers can no doubt see it at the I.E.E.

The Bell Telephone Co. of New York wanted this document for their museum but, as I was anxious for it to remain in this country, I had it photographed and sent a copy to America to provide a missing link in the history of the telephone.

Bradford. HARRY MOSS, M.I.E.E.

"Do It Yourself"

WHILE we have every sympathy with Mr. G. H. Cook's point of view (*Electrical Review*, 8th March), we must not forget that this is a free country and there is nothing that we can do to prevent the publication of articles of the sort he deprecates. In fact with the " Do It Yourself " movement growing fast it would be too much to expect that articles in magazines catering for this movement—and, possibly, other journals—would not include some references to electrical work, but it should be borne in mind that the number of their readers who will actually attempt to do work of this kind is probably quite limited.

Furthermore, they may be of the foolhardy types who would do this work whether instruction was given or not.

On the other hand I would like to point out that the services of this Association are always available for guidance to editors as to how far they should go in the direction of describing the construction of electrical apparatus and wiring without undue risk to the operator, and some editors avail themselves of these services. Whenever a journal publishes advice which seems liable to be dangerous to the "Do It Yourself" operator, or to the user of the appliance, the Association calls attention to the fact and seeks to have a warning note published in the next issue. Of course, just as we cannot prohibit the publication of objectionable articles, we cannot enforce the publication of our advice. But I feel that your readers may like to know the help that E.D.A. is able to give, so they may mention it in any letters of protest they may feel inclined to write to erring magazines.

London, W.C.2. JOHN M. FRASER,
Press Officer,
British Electrical Development Association.

Technological Awards

IN an address to the Annual Assembly of the Nottingham and District Technical Colleges in Nottingham recently Sir Harold Roxbee Cox, vice-chairman of the National Council for Technological Awards, described the work of the Council which has been established under the chairmanship of Lord Hives to create and administer awards in technology. It has already instituted a Diploma in Technology which will be awarded to those who successfully complete courses of study recognised by the Council. The courses will be at the level of a university honours degree.

"This new award," said Sir Harold, "has met with considerable initial success. Up to the present the Council has had 59 applications for approval of courses. It has completed consideration of 37 and has given its recognition in the cases of 28. As it has been possible for some of these approvals to be retrospective, we may well see between 40 and 50 candidates for Diplomas in Technology in 1958, and nearly a 100 in 1959."

He believed that this Diploma would rapidly take its place beside honours degrees from universities as a first rate qualification for an engineer or a technologist in any field. It represented a new alternative means of advanced education.

There were many young people who could not go to a university for financial reasons. The bright boy or girl from what were now called the lower income groups could get a grant which would take him or her to a university. The child of wealthy parents was almost equally privileged; but in between there were many children whose parents had incomes assessed by education authorities as too big to permit of the children receiving any pecuniary aid, and assessed by the Inland Revenue in such a way as to make them too small for the children to go to a university without pecuniary aid.

Sir Harold said it would be wrong too to suggest that the Council was satisfied with the calibre and the number of teachers in technical colleges dealing with the high level courses for the Diploma, and it would be interesting to see when they looked at standards in five years' time, what effects improved working conditions and the new Burnham Scales had had. The Council was approving courses on their merits. Whether a college was called a College of Advanced Technology, or a Regional College or an Area College, made no difference.

Computers for Nuclear Studies

THE discussion on the paper presented before the Institution of Electrical Engineers by Mr. G. J. R. MacLusky (*Electrical Review*, 15th March) on the application of analogue methods to nuclear research was opened by Mr. R. W. Sutton (English Electric Co.), who said that in considering the dynamic behaviour of a complex system such as nuclear power plant, it was necessary first to establish some form of mathematical model to represent the system. That would usually take the form of a number of first order differential equations (some or all non-linear) the solution of which required some form of computer. He agreed with the author regarding the value of the analogue machine in the facility it gave for readily changing the system parameters and for direct observation of resultant behaviour. He did not agree that, because one did not know the system parameter accurately, one could use a computer having a lower degree of accuracy.

Mr. I. Wilson (Atomic Energy Research Establishment, Harwell) showed a number of slides describing another application in an allied field, and reviewed some features of other computers in use at Harwell. Computers of the type described by the author were comparatively large pieces of electronic equipment, and the possible use of transistor techniques to reduce their dimensions might be considered.

Mr. R. J. Smith (Fraser & Chalmers), as a user of analogue computers and not a manufacturer, expressed interest in any proposal which limited the number of amplifiers and other components. There were 80 amplifiers in the computer he used, together with associated coefficient units, all of which had proved necessary.

Monsieur J. Weill, Monsieur P. Braffort and Monsieur C. Caillet of the Centre d'Etudes Nucleaires de Saclay, France, submitted written contributions to the discussion. M. Weill showed some slides made in the Electronic Division of the French Atomic Energy Commission Analogue Laboratory at Saclay, M. Braffort gave fuller details of the work done in the field of the thermal circuits of a reactor with a circulating moderator and of xenon poisoning, and M. Caillet gave some information on the effects of voids in a homogeneous reactor.

Mr. R. Potter (Atomic Energy Research Establishment, Harwell) referred to the author's statement that basic neutron kinetic equations were invariable for different reactors, and said it was true only of the first graphite-moderated natural-uranium reactors.

Mr. J. C. Nutter (Elliott Brothers) said there was a great need for information to be made available to design engineers as to how analogue computers could be used.

Prices of Materials

IN the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton	£197 0s 0d
COPPER, H.C. Electro	ton	£237 15s 0d
Fire Refined 99·70%	ton	£236 0s 0d
Fire Refined 99·50%	ton	£235 0s 0d
COPPER Tubes	lb	2s 3½d
Sheet	ton	—
H.C. wire and strip	ton	£288 15s 0d
LEAD, English	ton	£113 5s 0d
Foreign	ton	£112 0s 0d
MERCURY	flask	£85 0s 0d
TIN, block (English)	ton	£767 10s 0d
ZINC, G.O.B. Foreign	ton	£95 15s 0d
Electrolytic	ton	—
BRASS Tubes (solid drawn)	lb	1s 11½d
Sheet	ton	—
Wire	lb	2s 8½d
PHOSPHOR BRONZE Wire	lb	3s 11½d
PLATINUM	oz	£34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb	27½d—27⅝d

The President, Mr W. C. M. Couch, and Mrs. Couch, Mr. and Mrs. S. B. Warder, and Dr. T. E. Allibone and Mrs. Allibone

Batti-Wallahs' Ladies' Night

THE popularity of the annual ladies' night of the Batti-Wallahs' Society grows from year to year, and at last Friday's function held at the Connaught Rooms, London, there were 450 present, many prominent men from all branches of the electrical industry attending. Mr. W. C. M. Couch (president), who was accompanied by Mrs. Couch, presided. Informality is the keynote of these functions, and the speeches were both brief and light as befitted a festive occasion.

Mr. R. Clarke proposed the toast of the president and his lady in a witty speech in which he spoke of Mr. Couch's valuable work (as Deputy Director of Electrical Engineering to the Admiralty) in the electrical equipment of naval ships. He spoke of Mr. Couch's successful year of office and said he deserved full marks for securing the speakers who had addressed the monthly luncheons of the Society during the year. Mr. Couch responded in happy vein. He referred to the Society's close affiliations with the sea, and said that many of the older members had qualified under sail. He expressed the appreciation of all present for the evening's arrangements by the "Mate," Mr. T. C. F. Bigland.

The toast of "Sweethearts and Wives" was proposed by Mr. C. A. J. Martin, who paid graceful tribute to them, and Mrs. Couch, who replied, expressed the ladies' pleasure at being invited, and their enjoyment of the evening.

After the singing of the Batti-Wallah song "The Slave of the Lamp," there was dancing, during which some of the older gentlemen showed that the younger generation are not the only exponents of "Rock and Roll." There was also a first class floor show by Barry Manning's "Champagne" cabaret.

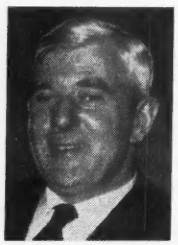
Mr. and Mrs. Forbes Jackson, and Sir John and Lady Hacking (on the right), with Dr. and Mrs. Hutchings, Mr. and Mrs. K. B. Bentley and Mr. and Mrs. P. J. Squire

Mr. C. A. J. Martin proposes the toast "Sweethearts and Wives," and (right) Mr. T. C. F. Bigland's table

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Central Electricity Authority has appointed **Mr. P. Briggs,** A.M.I.Mech.E., M.Inst.F., deputy controller of the North West, Merseyside and North Wales Division, to be controller of the Yorkshire Division in succession to **Mr. G. A. Vowles,** whose retirement at the end of this month was recently announced.



Mr. P. Briggs

Mr. Briggs was formerly the divisional controller of the Merseyside and North Wales Division before it was merged with the North Western Division in 1954. He received his engineering training in the workshop, drawing office and test department of Peter Brotherhood & Co., Ltd. at Peterborough. From 1925 to 1929 he held the post of charge engineer at Islington power station and then went to the old Fulham power station in the same capacity. Successively he was promoted to assistant operating engineer, maintenance superintendent in the new Fulham station, and then power station superintendent. When the electricity supply industry was reorganised in 1948 he became responsible for the control and operation of all the power stations in the South Eastern Division, and took up his appointment as controller of the Merseyside and North Wales Division in 1953.

Professor Niels Bohr, the eminent Danish physicist, has been given the first "Atoms for Peace" award which was established in 1955 at the time of the Geneva "Atoms for Peace" conference as a memorial to Henry and Edsel Ford. Professor Bohr has been Professor in Theoretical Physics in the University of Copenhagen since 1916. Earlier he was associated with Rutherford in his work in atomic physics at Manchester University. He received the Nobel Prize for Physics in 1922.

Mr. T. Litherland, A.M.I.E.E., first assistant district engineer, Cardiff East District, South Wales Electricity Board, has been appointed district engineer to the Ipswich District of the Eastern Electricity Board as from 1st April. Mr. Litherland received his training with the St. Helens electricity undertaking and has held appointments in the Wallasey District of the Merseyside and North Wales Electricity Board, the Luton District of the Eastern Electricity Board and the South West Fylde District of the North Western Electricity Board.

Mr. J. Gogan, chief commercial officer of the South of Scotland Electricity Board, has been nominated by the National Inspection Board as the first chairman of the Scottish Committee of the National Council for Electrical Installation Contracting. The first meeting of the Committee is to be held on 1st May.

A number of new staff appointments have been announced by Chilton Electric Products, Hungerford, Berks. **Mr. A. N. M. Harding** has been appointed south western sales representative. He was formerly working in the same area for Drake & Gorham Wholesale, Ltd. **Mr. A. Lloyd Thomas,** formerly domestic appliance manager, is now sales manager at Chilton, and **Mr. E. Theobald,** formerly London representative, has been appointed London sales manager.

Mr. J. H. Clucas, Graduate I.E.E., Graduate I.Mech.E., previously deputy station superintendent at Whitehall Road power station, Yorkshire Division, C.E.A., has been appointed deputy station superintendent, Newton Abbot power station, South Western Division, with effect from 1st April.

The **Faraday House Old Students'** annual reunion was held on 12th March following the annual general meeting when Mr. W. D. H. Gregson (sales manager, Ferranti, Ltd.) was elected president, Mr. J. W. Bailey (Ewbank & Partners) a vice-president, and Messrs. L. J. N. Kirkby (Admiralty Electrical Engineering Department), P. V. Fearon (technical director, Electrical Equipment & Engineering Co., Ltd.) and R. W. C. Reeves (director, Johnson & Phillips, Ltd.) were elected members of the Council. Mr. H. W. Swann, O.B.E., became hon. treasurer in succession to the late Mr. P. V. Hunter.

Mr. F. N. Pardow has resigned his position with Geo. H. Scholes & Co., Ltd., to work independently as a manufacturers' agent in Lancashire and Cheshire. He was for many years branch manager for the Simplex Electric Co., Ltd., at Liverpool, and later at Manchester, with an intervening period as a director of Mersey Cable Works, Ltd.

Mr. F. A. Field is leaving his present position as industrial and automotive sales manager of Black & Decker, Ltd., at the end of this month to become managing director of the Eutectic Welding Alloys Co., Ltd., Feltham, Middx. Mr. Field joined Robert Bosch, Ltd., in 1932 as a sales representative and he was later appointed sales promotion manager. He joined the Black & Decker organisation in 1938 and subsequently became home sales manager at the company's head office.

Mr. F. A. Field

The dining hall of the Magnet Club, Witton, was filled to capacity when the **G.E.C. Witton Apprentices' Association** held its annual dinner on 9th March. The principal guest was Professor J. M. Webster, Home Office pathologist, who replied to the toast

At the Faraday House Old Students' Reunion. Left: Mr. W. D. H. Gregson (president) and Mr. T. W. Child (past president). Right: Mr. C. Marsingall-Thomas (Air Ministry), Mr. A. H. Bennett and Dr. W. A. Coode-Adams (principal of Faraday house)

Mr. J. J. Gracie presenting the cup for the best all-round apprentice to Mr. I. M. G. Miller

of the guests, which was proposed by the vice-chairman of the Association, Mr. P. R. Game. The toast of the Association was proposed by Mr. W. J. Bird (home sales manager) and seconded by Colonel R. E. Keelan (manager of the Engineering Department in London)—both ex-Witton apprentices. Mr. P. L. Lockton, a student apprentice and chairman of the Association, replied. Prizes were then presented by Mr. J. J. Gracie (director). Mr. T. E. Robbins was judged the best trade apprentice, Mr. J. Froggatt the best drawing office apprentice and Mr. J. Hall the best student apprentice. The cup for the best all-round apprentice for services to the Association was won by Mr. I. M. G. Miller. Two apprentices tied for the honour of being the best all-round sportsman—Mr. K. D. Humphries, winner of the G.E.C. Golf Championship, and Mr. J. Sanderson, who won the Hugo Hirst Cup at the G.E.C. Championship Sports. Each will hold the cup for six months. The show which followed was written and produced by members of the Association.

Mr. W. Gardner and **Mr. L. R. Stuckey** (formerly of the Drake & Gorham (Wholesale) Manchester office) have joined F. Hulme & Co., Ltd., Manchester. Mr. Gardner will be with the subsidiary company, G. Ellam, Ltd., 49, Gartside Street, Manchester, 3, as commercial manager and Mr. L. R. Stuckey will represent F. Hulme & Co., Ltd., in Manchester and district.

A dinner was held recently in honour of **Mr. Hugo Falk,** chairman and managing director of Falk, Stadelmann & Co., Ltd., at the Trocadero Restaurant, Piccadilly Circus, W.1, on the occasion of his celebrating fifty years' service with the company. In addition to the board, the dinner was attended by all departmental, branch and works managers and sales representatives and warehouse staff with over forty years' service. In his reply, Mr. Hugo made reference to his frequent journeys round the world when a young man, which laid the foundation of the export business of the company.

Mr. E. G. Wright, A.M.I.E.E., author of the article on "Graphical Field Plotting" (page 507) began his career as a drawing office apprentice with Ferguson, Pailin, Ltd., and studied electrical engineering and later mechanical engineering at Manchester College of Technology. After working on switchgear design, he transferred to the Research Department in 1942 and was engaged on special testing and development work for circuit-breakers and switchgear units, specialising for several years in electrical contact phenomena, thermal investigations, electromagnetic problems and the application of graphical and mathematical methods to the solution of field distribution. He joined Ferranti, Ltd., in 1952 as a transformer development engineer, his work including the investigation of electrostatic field problems with an electrolytic tank and the relationship between stress and breakdown of dielectrics. He has just joined Ottermill Switchgear, Ltd., as chief designer.

Mr. Wright published a paper on "Graphical Field Mapping Applied to Bushing Insulator Design" in 1946, and in the same year contributed an article on "Surface Discharges" to the *Electrical Review*. The present article is a condensed version of a post-advanced lecture given in a course on "Field Plotting Techniques" at Salford Royal Technical College last year.

The South Western Area of the **Electrical Industries National Golf Championship** is again holding its annual qualifying match at Yelverton Golf Club, South Devon, on 25th June. In addition, this year there will be a separate event held at Knowle Golf Club, Bristol. This will be an open event for the Irens Cup. Score cards for the championship and entry forms for the open event may be obtained from the hon. secretary, Mr. A. Hughes, 7, Barton Street, Bristol, 1. The proceeds from both events will be given to the Electrical Industries Benevolent Association.

Mr. F. L. Mutlow was recently presented with a television set by his colleagues at Leeds and friends of the Yorkshire and East Midlands Electricity Boards to mark his retirement from the Revo Electric Co., Ltd., after thirty-seven years' service.

Dr. J. W. Bondi, Brigadier L. Bootle-Wilbraham and **Mr. G. H. Diggens** have been appointed directors of Brush Export, Ltd. Mr. Diggens has also been appointed a director of National Oil Engines (Export), Ltd.

The annual dinner and dance of the North Midland Centre of the **Institution of Electrical Engineers** will be held on 5th April at the Cairn Hydro Hotel, Harrogate. Tickets (25s each for members and 20s for students) can be obtained from Mr. H. A. Carr, c/o A. Reyrolle & Co., Ltd., 20, St. Paul's Street, Leeds, 1. Applications should be made by 29th March.

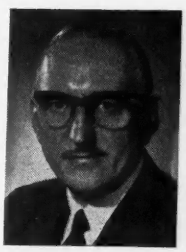
Mr. W. R. Owen was recently promoted from manager of the Sheffield branch office to manager for the North East region for Honeywell Brown, Ltd. **Mr. A. Hague,** his deputy for the past three years, succeeds him as manager of the Sheffield office. **Mr. Halstead** and **Mr. Gabe,** both of whom joined the company three years ago, have been appointed managers of the Middlesbrough and Cardiff offices.

Mr. F. Thompson, A.M.I.E.E., has retired from the position of London area representative of Genristo, Ltd., owing to ill-health. **Mr. L. Stern,** who has been appointed as representative in this area, has been in the wholesale electrical trade for many years.

Mr. H. H. Lusty, A.M.I.E.E., manager of the Publicity Department of the Metropolitan-Vickers Electrical Co., Ltd., has been elected a member of the B.E.A.M.A. Publicity Committee.

Mr. L. G. Piggott has transferred from the service division and has been appointed sales manager of Alfred Imhof, Ltd.

Mr. John Tesseyman is to join Ferranti Radio and Television, Ltd., as publicity manager and he will operate from the company's head office at 41/47, Old Street, London, E.C.1, after 31st March.



Mr. J. Tesseyman

Mr. Tesseyman has been in charge of radio and television publicity for Ferranti, Ltd., since 1951, and before taking up his publicity appointment, was a member of the sales staff.

Mr. F. W. O'Loughlin, until recently manager of the Hoover, Ltd., Leicester district, has been transferred to the company's organisation in Germany for special duties. **Mr. K. D. Walsh,** formerly an area manager in the Bradford district, has been appointed district manager in Leicester.

The guest speaker at the annual dinner of the **Association of Supervising Electrical Engineers** which will be held at the Connaught Rooms, London, on 5th April will be Mr. Reginald Maudling, M.P., Paymaster General. Other speakers will be Sir Vincent de Ferranti and Mr. H. E. J. Butler, the Association's national chairman. Sir Harold Bishop (president) will propose the toast to the guests and Mr. B. L. Metcalf will respond.

The Siemens & General Electric Railway Signal Co., Ltd., announces that **Mr. F. Edwards,** commercial manager, has been appointed assistant general manager, and that **Mr. F. G. Mitchell,** assistant commercial manager, is now commercial manager.

OBITUARY

Mr. Jens Lassen Dornonville de la Cour, a pioneer in the field of electrical engineering, and with Professor Bragstad joint inventor of the cascade-convertor made and marketed in this country by Bruce Peebles & Co., Ltd., as the Peebles-La Cour motor convertor, died on 5th December at the age of eighty. Though a Swedish citizen, he was born in Denmark and educated at Zurich. After research and teaching posts, he was appointed chief engineer of Bruce Peebles & Co., Ltd., in 1904, joining A.S.E.A., Vasteras, in 1907 but retaining an interest in the Scottish company in a consultative capacity for many years. In 1914 he was appointed director of Norsk Hydro, and in 1918 founded Svenska Elektromekaniska Industri AB, of which he was managing director and later chairman till his retirement in 1949.

Mr. G. Bright, of the Estimating Department at the Trafford Park Works of Lancashire Dynamo & Crypto, Ltd., died after a short illness on 8th March. He was sixty-five years of age. Mr. Bright had completed thirty-two years in the service of L.D.C.

Mr. E. S. S. Hennen, Ludlow District manager of the Midlands Electricity Board, died recently at the age of fifty-two.

Mr. Robert W. Wilson, assistant chief accountant in charge of the Nottinghamshire and Derbyshire Districts of the East Midlands Electricity Board, has died in Derby City Hospital at the age of fifty-seven.

NEW E.D.A. DIRECTOR

Mr. J. I. Bernard to Succeed Mr. V. W. Dale

IT was announced some months ago that Mr. Victor W. Dale had expressed his desire to retire from the position of director and secretary of the British Electrical Development Association as soon as a successor could be appointed. Concurrently, the post was advertised at a commencing salary of "not less than £3,250" and a large number of applications was received. Last week we briefly reported that Mr. J. I. Bernard, B.Sc.Tech.(Hons.), M.I.E.E., M.I.H.V.E., had been appointed. He will take over on 1st April, but Mr. Dale will continue to be associated with E.D.A. until 1st July in order to meet his existing commitments.

Mr. Dale's association with E.D.A. began before its inception (to use an Irishism) for it was while he was at West Ham that his chief, the late J. W. Beauchamp, conceived the idea of such an association and when Mr. Beauchamp left to become the first director it was on the condition that Mr. Dale joined him as business manager. That was in 1919 and so for close on forty years Mr. Dale has been active in electrical development in its great variety.

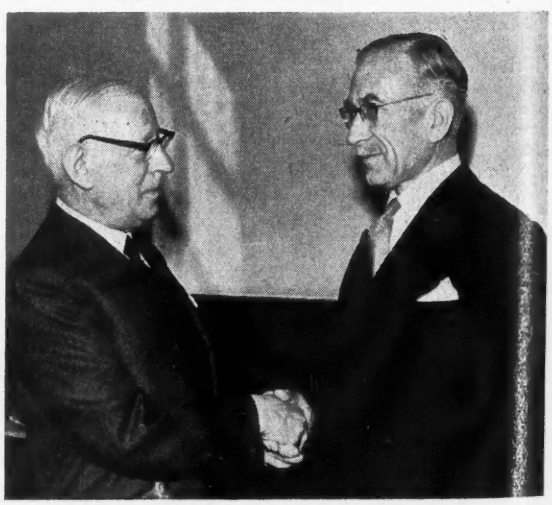
When the late Mr. A. C. Cramb (who followed Col. W. A. Vignoles, Mr. Beauchamp's successor) retired from the directorship Mr. Dale was appointed general manager and secretary and it was not until 1954 that he was given the title of the position which he had held since 1943. Known affectionately as "Victor" to nearly everybody in the electrical industry, he can truly be said to have done as much for the advancement of electricity as anybody and the industry is greatly indebted to him. It has always been hard work but probably never so hard as in the earlier years—a struggle recounted by Mr. Dale in the *Electrical Review* of 23rd June, 1944. Beauchamp's idea was, of course, to sell more electricity but he and Mr. Dale found that they first had to "sell" the Association to the electrical industry and this was no easy matter. Eventually they abundantly succeeded and now Mr. Dale can look back with justifiable satisfaction upon his life's work. We wish him many years of happy retirement—or, as it will probably prove, semi-retirement, for he intends to maintain an active interest in electrical affairs.

The choice of Mr. Bernard as the new director is a good one, for next to Mr. Dale nobody knows more about electrical development and the work of the Association than he does. He joined E.D.A. in 1927 and has been its chief technical officer since 1936.

Mr. Bernard was born at Warrington in 1898 and received his education at Brighton College and the Manchester College of Technology. His training and early experience was comprehensive; he was successively with the B.T.H. Co., British Westinghouse and the Manchester Electricity Department. From 1921 to 1925 he was a technical assistant with the British Engineering, Boiler & Electrical Insurance Co., and was then for two years technical assistant with the Electricity Commission, dealing with the engineering aspects of applications for sanction to the erection of power stations, bulk supplies, overhead lines and distribution extensions. He served in the R.E. Wireless Section from 1916 to 1919.

Mr. Bernard has been active in many directions. He was a member of the first Committee of the I.E.E. Installations Section and in 1954-55 was chairman of the Utilisation Section. He was on the I.E.E. Post-War Planning Committee on Electricity Supply, Distribution and Installation and is a member of the Wiring Rules Committee. He has been chairman of the E.R.A. Sub-Committee on Space and Water Heating since its inception and is a member of other E.R.A. and B.S.I. committees. He was concerned with the establishment of the E.D.A. Testing House, following the formation of the E.D.A./B.S.I. Advisory Committee on Electrical Appliances of which he has been joint secretary. In this capacity he has been a member of the C.E.E.

As technical officer of E.D.A. Mr. Bernard has been responsible for the technical side of advertising and publicity, including articles and booklets on a wide range of subjects connected with domestic, rural, industrial and commercial applications of electricity.



Mr. V. W. Dale (left) with his successor, Mr. J. I. Bernard

Rectifier Locomotives

Equipment for Single-Phase 50 c/s Systems

TWO papers on the single-phase 50 c/s system of railway electrification (now adopted in France, Turkey, Portugal, the Belgian Congo and Great Britain) were presented on 14th March before the Institution of Electrical Engineers by authors who are with the English Electric Co., Ltd.

The first, by Messrs. H. B. Calverley, E. A. K. Jarvis and E. Williams, dealt with electrical equipment for rectifier locomotives. The advantages and disadvantages of various types of power circuit discussed included h.v. and l.v. control, on-load tap-changing, buck-boost control, stepless control, bridge and bi-phase rectifier circuits and methods of connecting motors. No ideal solution of the problems of compromise and co-ordination by designers of the equipment as a whole was yet apparent.

Usually the transformer on the locomotive for stepping down the 25 kV in general use to rectifier voltage was arranged for on-load tap-changing from zero to maximum output voltage; this formed the main method of control of locomotive power. The lap-wound series-field motors were almost identical with those used on straight d.c. or diesel-electric systems. The associated rectifiers were connected to give a full-wave output voltage; a reactor in the d.c. circuit limited the ripple current resulting from a voltage of twice the line frequency in the output.

Braking and Adhesion

Although regenerative braking was technically feasible, using grid control and separately excited motors, rheostatic braking had been generally preferred as being less complicated. With parallel connection of the motors of a rectifier locomotive and control by voltage variation, the useful coefficient of adhesion was highest and the slipping of one pair of wheels had little effect. This connection might, however, increase unduly the size and cost of the equipment as a whole. At a lower adhesion factor these disadvantages were sometimes reduced by connecting two motors permanently in series. Compared with four motors in parallel, the rectifiers for this circuit would be rated at twice the voltage and half the current; the rated power output of mercury-arc rectifiers generally increased with voltage. In an intermediate arrangement wheel-slip conditions could be controlled by introducing an equaliser connection between the motors. Field-weakening at higher speeds added weight and was justifiable only for mixed-traffic locomotives or to give a higher power output at maximum speed. For a given armature volume a four-pole motor weighed 10 to 20 per cent more than a six-pole machine. The maximum rated voltage was reduced by about one-third; the corresponding increase in current rating was a disadvantage for mercury-arc rectifiers and the control equipment but not for semi-conductor rectifiers.

Tap-changing on the high-voltage control system had been used in Europe, but it was done on the low-voltage side in the U.S.A. as well as for the three motor-coaches so far built in Great Britain.

Control of the output voltage of a mercury-arc rectifier was obtainable by varying the phase of the grid or ignitor impulse in relation to the anode voltage wave; the method gave an infinitely smooth increase in traction effort at standstill and also reduced equipment weight.

The multi-anode rectifier was more suitable than the single-anode type on account of its size and shape and the ability to use bridge circuits. Outputs at from 600 to 900 V were required for six-pole motors; at 800 h.p. per axle, this meant 1,100 and 750 A continuous rating. The water-cooled pumpless ignitron had been used almost exclusively, but the circuits for firing the ignitors were somewhat complicated and the ignitors had possibly a limited life compared with that of the complete rectifier, so that two or three were usually fitted to each set. The excitron did not suffer from these drawbacks, but it needed a cathode insulator and an ignition device, which increased its weight, while its construction was more complex.

Semi-conductor rectifiers were simpler but not competitive in price at present. Germanium gave little reduction in size at traction-motor voltages and little gain in efficiency. Silicon could operate at much higher temperatures than germanium and saved space and weight considerably. Both types had very short heating-time constants and needed to be continuously rated for operation at the acceleration current; fuses were necessary to give high-speed protection against faults.

The effects of ripple current in the motor circuits (between 20 and 50 per cent was normally allowed) and the influence of non-inductive field diverters were considered. The value of ripple current chosen by the locomotive designer influenced conditions in the supply network. If made small through adequate smoothing, the network displacement power factor was improved, but the distortion power factor was worsened because the harmonic currents in the network were greater.

Circuit Calculations

Accurate calculation of power factor and harmonics in the line had to be made according to rigorous undulating-current theory. This theory was dealt with in the companion paper by Messrs. T. E. Calverley and D. G. Taylor, who outlined the calculations for bi-phase and bridge circuits, based on the accepted "infinite-inductance" theory, and derived the direct voltage at the motor, ripple current in the motor circuit, and the power factor and harmonics in the a.c. supply. The authors then described a new approach to the solution of both steady-state and transient rectifier problems, which took account of resistances, inductances and capacitances in all parts of the circuit. These were treated as circuit problems, the equilibrium equations being established in terms of mesh currents and expressed as simultaneous first-order differential equations. A digital electronic computer was employed which took account of the valve action of the rectifying elements. The results of the calculations (which illustrated the imperfections of the accepted theory) were supported by tests carried out in conjunction with British Railways on the Lancaster-Morecambe-Heysham section.

DISCUSSION

The discussion was opened by Mr. E. L. E. Wheatcroft (Merz & McLellan) who deprecated bothering about the so-called simple infinite inductance theory. This seemed to have no merits except possibly that one could present

all the parameters on a single curve plotted against angle of overlap. Anyone with access to "Deuce" or a similar digital electronic computer could, however, work out the results for all likely variations of inductance and resistance, both on a.c. and d.c., and could give the answers in a family of curves. In default of access to "Deuce" he suggested setting up a model, as the circuits presented required no more apparatus than was to be found in any university engineering laboratory.

Dr. J. C. Read (B.T.H.), referring to the paper on electrical equipment, said he had been surprised at the authors' advocacy of water cooling, as he thought it was accepted that air cooling was simpler and preferable. He did not believe that space saving was important on a locomotive. American traction engineers regretted the necessity of using ignitrons because of great difficulty in designing the ignitor firing circuit, if of the static magnetic type, to operate with complete reliability over a sufficiently wide range of a.c. supply voltage. He did not agree that the semi-conductor rectifier was as yet not competitive; it was worth while because it could drive straightaway on a cold morning without heating up. There was certainly great hope in the future for silicon. Germanium had been in operation for about a year without the slightest trouble and had reached the stage where it was suitable for application until silicon was available.

Dr. W. G. Thompson (General Electric Co.) said that the use of a digital computer allowed the whole field of variables to be scanned, particularly those dependent upon waveshapes and harmonic quantities. The virtues of that feature were that the essence of the work was largely directed to the actual ratings of the components to be mounted on the vehicle and that size limitation placed a premium on optimum design, for which the computer was a valuable aid.

Changed Conditions

Mr. S. B. Warder (British Railways) said that since the decision of the Commission to adopt the a.c. system as the future standard of British Railways, experimental testing had moved to the Manchester-Crewe line and the Clacton-Colchester section of the Eastern Region. Hence the conditions under which much of the information presented in the papers had been obtained were entirely different from those which would apply in future, including the system as a whole, the rolling stock and the equipment.

Dr. H. von Bertele said at present single anodes of about 500 A average rating, both excitron and ignitron, would have something like 25 or 35 lb of mercury in each valve. Mercury was heavy and was liable to splash with the swaying of the vehicle, so that precautions to protect the electrodes were necessary. A suggestion made two or three years ago was that much mercury might be saved by thermal control of the ignition zone, and in some work which he had done the mercury content had been brought down to about 10 per cent. Further development had shown the possibility of restricting the mercury to one thin film.

Mr. J. A. Broughall (British Railways) pointed out that the railway traction engineer was restricted by rather severe parameters. For example, the axle load must not exceed a certain amount, both the first cost and the maintenance costs of the locomotive had a bearing on the number of wheels and, of course, the traction engineer could only go from one whole number of wheels to another, say, from four to six. Finally, trains which on occasion would run at one hundred miles an hour were required, but the authors apparently treated every pound and every ton as being of equal value, which was not in fact the case; if one exceeded twenty tons per axle one could not run over certain lines at all.

Mr. J. C. Turrell (General Electric Co.) said the tendency in recent years had been to stress the advantages of rectifying equipment in enabling higher adhesions to be worked to. That was an admirable feature, but it was common to all systems whereby motors could be connected in parallel and have a voltage control. The main traction essential was to share the load as evenly as possible over the several motors and to be able to start the train without a multiplicity of control gear.

Mr. F. C. E. Smith held that low-voltage tap-changing was more practicable on rectifier locomotives than on a.c. commutator locomotives, owing to the higher design voltage of d.c. motors. High-voltage tap-changing had therefore been well developed on the Continent on a.c. commutator locomotives, and was favourable to good maintenance in that it required only three oil seals external to the transformers and only two breaking switches.

Mr. W. R. E. Taylor, referring to the weight of the main transformer, suggested that aluminium windings might be considered in an attempt to reduce the weight.

Motor Starters and Controllers

A NEW edition of the twenty-year-old B.S. 587, "Motor Starters and Controllers," has just been issued by the British Standards Institution. The Standard now applies to a wide range of different types of hand-operated and automatic starters and controllers as used with a.c. motors of rated voltage up to 11 kV and d.c. motors up to 650 V. Requirements for resistors and auto-transformers and similar equipment associated with motor control gear are also included.

Standard ratings are specified on the basis of the main mechanical and electrical duties for which control gear is required, and standard sizes of starters and controllers are recognised in terms of motor horse-power. Full details are included of the standard duty ratings for resistors for use in motor control gear which have been generally recognised in industrial practice and in previous editions of B.S. 587.

The design and constructional requirements deal with many aspects of control gear including, for example, details relating to mounting, provision for earthing and earth continuity, preferred standards for push-buttons and indicating lamps, undervoltage and overload devices, overcurrent and breaking capacities, etc. Limits of temperature rise for various types of contacts, conductors, coils, auto-transformer windings and resistors are specified.

The type tests include main current heating tests, voltage tests on shunt coils and electrical performance and mechanical endurance tests. The routine tests comprise a high-voltage insulation test and tests on resistors, auto-transformers, voltage coils and overload devices.

Seven appendices provide additional information on temperature measurement, clearance and creepage distances and resistor ratings, together with a graphical presentation of the maximum starting times for various types of motor starters. There is also a summary of the special requirements for switching starters for a.c. motors of 1 to 25 h.p. The Standard was prepared under the authority of the Electrical Industry Standards Committee.

Copies of B.S. 587:1957 may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 8s.

Mains Frequency Induction Furnace

DEVELOPMENT work on the mains frequency coreless induction furnace which began about four years ago has resulted in the first of several production units now under construction being commissioned at the foundry of International Combustion, Ltd., Derby.

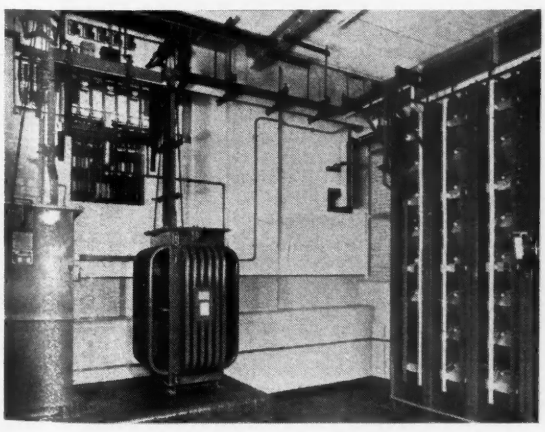
Similar furnaces were developed in Germany by Otto Junker shortly after the end of the war and Birlec, Ltd., installed a small experimental prototype at a works in Coventry in July, 1955. It was known that independent development on similar furnaces was being carried out by the Ajax Engineering Corporation, Trenton, New Jersey. Ajax and Birlec had collaborated for many years on the production of the "Tama" channel-type furnace. Subsequently an agreement was made between the three companies for the development and marketing of mains frequency coreless induction furnaces.

The installation at the International Combustion foundry will be concerned mainly with spheroidal graphite cast iron to be used in place of steel castings and complicated steel forgings which at present form components of pulverising mills, powdered fuel burners, coal feeders, travelling grate stokers, spreader stokers and various components of grinding, screening and filtering plants.

Description of Plant

The furnace consists of a melting chamber or crucible which is cylindrical in shape and lined with a rammed refractory. It is surrounded by a helical water-cooled copper coil through which a heavy current is passed to induce the necessary heat in the charge. The 50 c/s current also induces a vigorous stirring action which ensures a uniform temperature analysis. The induction coil is wound of a specially shaped section in high conductivity copper. It is designed for maximum electrical efficiency, safety in the event of a metal break-through, and free passage for the necessary cooling water which is supplied by flexible hoses. The coil is supported and restrained axially by spring-loaded end rings, and radially by packets of transformer iron which also constrain the magnetic flux and permit the use of a solidly welded steel outer casing.

General view of substation. The furnace and reactor capacitor banks are shown on the right



Pouring view of Birlec 5-ton mains frequency coreless induction furnace. The control panel can be seen in the background

The furnace is tilted for pouring by hydraulic rams, one on each side of the body. A vane type electrically powered pump supplies the fluid which is controlled by a valve mounted on the control stand of the furnace platform. A 420 V a.c. supply is fed to the equipment through a main on-load contactor and an isolator which is mechanically interlocked with the substation door and with the entrance to the furnace excavation. This ensures that access to the substation is only possible when power is switched off. The provision of adequate tappings on the transformer gives a wide range of power inputs and in turn enables any degree of superheating or melting to be achieved.

In the same tank as the transformer is a reactor associated with a static balancer to give a reasonably balanced three-phase load on the incoming supply mains. In order to correct the coil power factor to unity, a bank of 50 c/s capacitors are connected in parallel across the coil, the power factor correction capacitors being mounted in the substation immediately behind the furnace platform. The water supply is controlled from a cabinet below the instrument panel and monitoring relays are provided which shut off the power and give warning in the event of a failure in the water supply. Provision has been made for an emergency water supply to be available in order to protect the furnace coil.

The first lining of the present furnace is of a high silica material rammed round a sheet steel former that is melted out with the first charge, thereby sintering the lining. The life of the lining of a mains frequency coreless furnace has been found in practice to be satisfactory up to very high temperatures. When melting iron it is normally about 150 heats when a pouring temperature near 1,500 deg C is used. For steel, any number between 30 and 150 heats may be obtained from one lining, depending

on the temperature and type of material used, while for light alloys the lining life is infinitely long.

Between temperatures of 1,350 and 1,550 deg C the superheating rate is about 5 tons/hr/100 deg C with an approximate power consumption of 60 kWh per ton, and the melting rate is approximately 8 cwt/hr with power consumption of 670 kWh per ton. At first sight the latter figure may appear to be on the high side but it must be remembered that this is a large furnace body, primarily designed for superheating and holding hot metal and not for melting; consequently the electrical input at 300 kW is small in relation to the furnace size. This reduces the melting rate and therefore increases the energy consumption per ton to be melted.

The British manufacturers already have orders for fourteen installations for a wide variety of applications with both ferrous and non-ferrous metals. The sizes of the furnaces on order vary from 12 cwt to two units of 15 tons which will be amongst the largest induction melting furnaces in the world.

Siting of Nuclear Power Stations

LORD MILLS, the Minister of Power, announced in the House of Lords last week that one or more of the proposed nuclear power stations would be built in Wales if suitable sites could be found.

Lord Lawson had initiated a debate on the siting of the new nuclear power stations, calling attention to the fact that by deciding to put the stations in remote areas the Government were endangering what remained of our unspoilt countryside. He thought it would be far better to site the new stations in built-up areas.

Lord Rea observed that if Calder Hall had been erected in a depressed area a few miles north of where it was it would not have trespassed on an area of natural beauty. When such projects were planned the amenity bodies, local interests and sometimes even the owners of the property were not aware of what was going on until it was too late.

Lord Hylton said that during the last five months he had been conferring with the Central Electricity Authority about the siting of a new atomic power station at Bridgwater Bay. He was bound to say that the Authority, to the best of its ability, had made public its proposals to all the local authorities in the area. If it was duplicated, as he understood was likely, the Bridgwater station would occupy a third of a mile of the coast. The buildings would be utterly out of scale with anything yet erected in these remote areas. He understood that the C.E.A. was prepared to spend a certain amount of money to diminish the effects on the natural scenery but it might not be enough. At Bridgwater Bay, by moving the site slightly in one direction it was possible to gain cover from low ranges of hills, thereby concealing to some extent the great bulk of the buildings. The cost of the two stations would be about £80 million and the cost of moving the site might be about £2 million.

Viscount Hall suggested that some of the stations should be sited in the vicinity of the coalfields where, between now and 1965, there would be a reduction of 100,000 in the number of miners employed in the pits.

Lord Chorley, who is honorary secretary of the Council for the Preservation of Rural England, referred to the extreme anxiety which was felt about the siting of stations in remote areas and said Lord Mills and his Department might well toll the death knell of England's green and pleasant land if this programme went ahead in the way that many people feared it would. The Government should relax the rule about stations being put far away from built-up areas. The Minister should also consider adding a planning expert to the technical committee which advised him about the siting of stations.

Lord Mills, replying to the debate, said it had been decided that, for the present, the policy must be to choose sites for the nuclear power stations away from built-up areas. It was not that they were in any way liable to accidents. It was because they contained highly toxic materials and they represented a new development which had not stood the test of operation on a large scale. "But this is a flexible programme, and we will be guided by experience as we go along," he said.

The business of finding sites, having consultations with all concerned, and holding public inquiries took nine months on the average, but there were occasions when the period was doubled. It was wrong to say that at the public inquiry the Minister was judge in his own cause. He was really the spokesman for all the Government Departments concerned and pronounced his decision on behalf of himself and all his colleagues. When it was proposed to erect transmission lines wayleaves were usually agreed to voluntarily. Up to this year wayleaves for 835 miles of line out of a total 857 had been agreed to voluntarily. There were some difficult cases and they brought on to the Electricity Authority a lot of publicity which it did not deserve. Public relations would be of vital importance to the ambitious programme for nuclear power.

That there would be effects on the countryside was certain. It was part of the price we had to pay, but given good will all round and a helpful attitude, these effects could be greatly minimised. To ensure that the general design and main architectural features were not incongruous in the landscape the C.E.A. referred the plans to distinguished architectural consultants and consulted the Royal Fine Art Commission on siting and design.

National Institute for Nuclear Research

THE Governing Board of the National Institute for Research in Nuclear Science have held their first meeting in the offices of the University Grants Committee, Belgrave Square. The Board had a general discussion of the main tasks laid upon them by the Government. They appointed a Physics Committee with the primary responsibility of examining proposals and designs for the construction in this country of a large accelerator.

The chairman of the Board is Lord Bridges and other members are as follows:—Representing the universities: Sir Philip Morris, Sir James Mountford, Professor N. F. Mott, Professor H. S. W. Massey, Professor J. Diamond, Professor R. E. Peierls and Dr. D. H. Wilkinson. Representing the University Grants Committee: Sir George Thomson and Mr. J. C. Gridley. Representing the Royal Society: Sir David Brunt. Representing the Atomic Energy Authority: Sir John Cockcroft, Sir Donald Perrott and Dr. B. F. J. Schonland. Representing the Department of Scientific and Industrial Research: Dr. H. W. Melville and Professor P. M. S. Blackett.

British Standards Yearbook

THE Yearbook of the British Standards Institution, just published, contains a complete numerical list of the 3,000 British Standards and Codes of Practice current on 1st January, 1957.

Apart from its main purpose as a reference directory to all current British Standards, the Yearbook contains information relating to the services which the Institution can offer, notes on the British Standards mark of approval and the standards to which it is applied, and details of the Canadian Approvals service whereby electrical gear can be "approved" for export to Canada before leaving this country. Other information includes lists of addresses in the United Kingdom and overseas where complete reference sets of all British Standards can be consulted. A comprehensive index is also included in which all standards are listed according to subject.

Copies of this useful 480-page reference book have been sent free to all the Institution's subscribing membership. Non-members may obtain copies at 15s plus 1s 6d postage.

Nuclear 1,000 MW Stations Envisaged

SIR JOHN COCKCROFT ON NEW PROGRAMME

SIR JOHN COCKCROFT, Director of the Atomic Energy Research Establishment, Harwell, addressing the Parliamentary and Scientific Committee last week, recalled that the first three stations of the electricity authorities were to have outputs of 275 to 300 MW. It was thought that the process of straightforward engineering improvements would continue, leading to greater output from roughly the same size of reactor and therefore to the reduction of capital costs per kW of the order of 20 per cent or so in the "second generation."

Perhaps in the third group of nuclear power stations it might be possible to introduce more radical changes in design. For instance, they would like to increase the temperature of the fuel elements from 400 to 600 deg C and produce a uranium fuel which would withstand the higher temperature. Mr. R. V. Moore (the designer of Calder Hall) suggested recently that if they could achieve 600 deg C they might be able to generate 400 MW from a single reactor, so that a two-reactor station would give 800 MW. Therefore they could already foresee the 1,000 MW station.

Other technical possibilities were open. Instead of using round solid fuel rods of the Calder or improved Calder type, they could go to rods using a series of flat plates, thus increasing the surface area and providing for still more heat dissipation.

The original twelve stations at the design output of the first C.E.A. station would give a total output of approximately 3,500 MW by 1965. The Government's new plan provided for raising the total to 5,000-6,000 MW by that date.

The programme would require increased facilities for the production of fuel elements and for the re-cycling of the uranium more economically. Private industry would produce the increased supplies of graphite which would be needed.

Sir Josiah Eccles, deputy chairman (operation), Central Electricity Authority, spoke of the siting of atomic stations. He said that the stations the C.E.A. had ordered were rated at 300 MW and there was a good chance that they would soon be able to order 500 MW stations. That size was important, apart from price, because for a given programme the bigger the individual station the fewer the number of stations required. Since the stations had to be built in places which had not been touched very much by industry and the transmission lines had to go from the stations to industrial areas and traverse rural areas, there was an amenity problem.

They were very anxious to preserve the amenities of rural England but, on the other hand, they were charged with the duty of providing an essential power supply without which we could not survive as an industrial nation. They asked for the co-operation and sympathetic understanding of all those who might be affected by their work.

Housecraft Advisers' Conference

SOME 400 women representatives from Electricity Boards from all over the country attended the annual four-day conference of electrical housecraft advisers, organised by the Electrical Development Association and the Electrical Association for Women in London last week.

Mr. D. Bellamy (chairman of the E.D.A. Council and of the Yorkshire Electricity Board) in his opening address said that the electricity supply industry had now reached the position of fighting for the most competitive market—electric cooking and water heating. He pointed out that if the railways were fully electrified the total consumption would be about one-eighth of the potential load of electric cooking and water heating in the domestic market. For a long time E.D.A. had been setting up machinery to capture the market, and the demand had grown rapidly. Electricity was now being sold for cooking and water heating at a price which was more than competitive with gas.

Miss Mary George, recently appointed director and secretary of the E.A.W., was then introduced to the conference by Mr. Bellamy. She said that there should be more opportunities for women in all branches of the electrical industry. With very few exceptions demonstrators were the only women with professional qualifications employed in the industry and they were very much restricted within their own particular field. Following her address Miss George presented the Elizabeth Sloan Chesser Cup to Miss B. J. Cawood (L.E.B., Walthamstow).

In presenting a paper entitled "The Domestic User of Electricity," Mr. U. F. Murray (assistant chief commercial officer, South of Scotland Electricity Board) said that with the coming of atomic power development of the off-peak load was essential. Water heating was a good product and a good load; yet statistics showed that 80 per cent of consumers were still without electric water heating. It was hoped that the extremely valuable load represented by electric storage space heating would in time be available to the domestic user as well as to industry. On the subject of electric cookers he said that 75 per cent of the consumers had still to be convinced that electric cooking was the best method. The electric kettle was a most useful load builder but 70 per cent of consumers had still to buy one.

The afternoon session consisted of a paper by Miss B. A. Crang (Bristol University Research Station) on fruit bottling methods and freezing foods in the home.

Wednesday's proceedings opened with Miss Muriel Marris (senior housecraft adviser, South Wales Board) presenting a paper entitled "Electricity Through Life." She pointed out that it was the demonstrators' job to instil into the minds of all with whom they came in contact that the electrical way of life was best. Ten demonstrators from other Area Boards assisted Miss Marris by relating their own experiences on various subjects which she had chosen.

At the afternoon session Mrs. Key (Prestcold) presented "Demonstrate to Sell," a selection of ideas from manufacturers' housecraft advisers. She was followed by Mr. H. G. F. Gamble (Eastern Electricity Board), who gave a brief description of the main points of interest at the Ideal Home Exhibition, which the delegates visited on Thursday.

The final day of the conference (Friday) was spent at the Connaught Rooms where the delegates were given an outline of the City and Guilds examinations and requirements with special reference to the E.A.W. Certificate in Electrical Housecraft for Demonstrators, by Mr. D. C. Lucia (deputy director, City and Guilds Institute).

The conference concluded with a luncheon and the opportunity was taken by Mr. V. W. Dale to present his successor as director and secretary of E.D.A., Mr. J. I. Bernard.

INDUSTRIAL NEWS

The Strike Situation

Since Monday the country's shipbuilding industry has been at a standstill, the Confederation of Shipbuilding and Engineering Unions having rejected arbitration in their dispute with the employers.

At the time of going to press it seemed likely that strike action would be taken by the engineering trade unions to enforce their claim for a 10 per cent increase in wages, although talks were proceeding between union and employers' representatives and officers of the Ministry of Labour. It had not then been decided whether the unions would call out all their members in the industry or those in selected firms or districts.

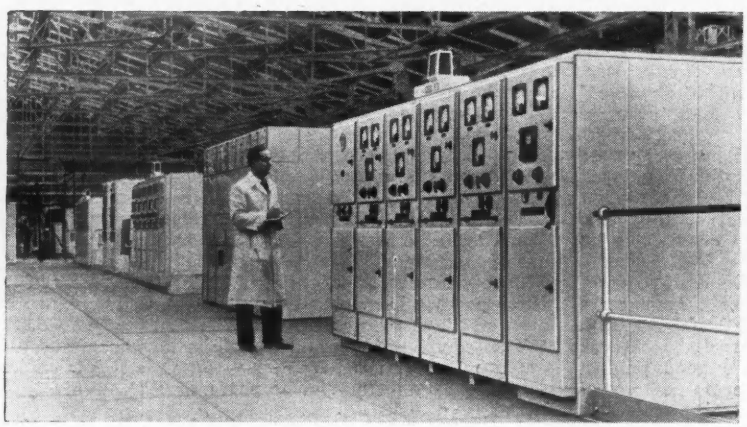
Atomic Energy Expenditure

A total amount of £98·8 million is given as the estimated expenditure upon atomic energy in the Civil Estimates for 1957-58, £26·8 million more than 1956-57. Grants to the Atomic Energy Authority for works services, plant and machinery total £56·1 million, including £5·8 million for new works and £16·5 million for works in hand. The cost of plant and machinery for establishments is put at £33·9 million and loans to the Authority for uranium production at £7·5 million.

Switchgear for Atomic Energy Authority

An order for switchgear valued at approximately £250,000 has been obtained by the British Thomson-Houston Co., Ltd., from the United Kingdom Atomic Energy Authority. It comprises thirty-two 3·3 kV, 150 MVA, 6-panel air-break, truck type switchboards for installation at the Authority's Capenhurst Works. This is the third such order received by the B.T.H. Co. from the U.K.A.E.A. for similar equipment. In the accompanying picture is shown one of the switchboards included in the first contract, installed at Capenhurst. Altogether ninety-six switchboards have now been ordered from the B.T.H. Co. for Capenhurst.

One of the B.T.H. switchboards installed at the Capenhurst Works of the U.K.A.E.A.



Heavy Plant Production in India

It is reported from New Delhi that the Government of India has accepted the plans drawn up by Associated Electrical Industries, Ltd., for the erection of a works in Bhopal, Central India, for the manufacture of heavy electrical plant. An expenditure of about £35 million is involved and the work would take about twelve years.

Associated Electrical Industries, Ltd., were appointed consultants for this purpose in 1955 and presented the project which has now been adopted to the Government of India in November last. The factory will be State-owned and operated.

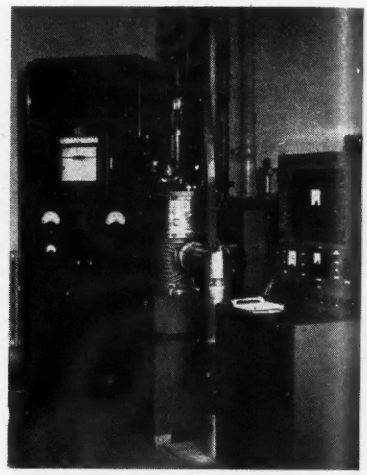
Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 16th March is deemed to be 175s.

The "cost of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 16th March is 184·9. For turbo-generating and allied plant: Materials used in mechanical engineering industries 182·1, blast furnaces and iron and steel melting and rolling (40 and 41), 177·6. The price of ¾in o/d s.w.g. brass condenser tubes (*Metal Bulletin*, 15th March) is 46¾d per lb.

Large Germanium Crystals

One of the largest single-crystal ingots of germanium in the world has been grown recently at the research laboratories of the General Electric Co., Ltd., where a research programme on transistors and other crystal valves is in progress. The ingot, which is about 8in long and weighs 1,200 gm, took about 6 hours to grow. It was produced by a process involving the slow withdrawal of a rotating "seed" crystal from a pool of molten germanium.



G.E.C. automatic machine for growing large germanium crystals

The company has developed this technique to the stage where large crystals such as this can now be grown automatically with great consistency and uniformity. The value of the ingot is approximately £650 and the impurity content is controlled to a value of less than one part in twenty million.

In the manufacture of crystal valves the production of such large diameter crystals results in considerable savings in cost. When the ingot is sawn into wafers, less material is lost as waste from the trimming of the outside and ends, and higher productivity is obtained from each machine producing the ingots.

Royal Visit to Cable Works

The Duke of Edinburgh visited the factories of Submarine Cables, Ltd. (owned jointly by Siemens Brothers & Co., Ltd., and the Telegraph Construction & Maintenance Co., Ltd.), at Greenwich and Erith on 13th March, and inspected their new cableship *Ocean Layer* which was engaged in loading cable from the storage tanks at Telcon Works, Greenwich. The cableship sailed on 15th March on a cable laying expedition off the west coast of Africa under charter to Cable & Wireless, Ltd., with 627 nautical miles of cable to carry out renewals to various telegraph cables, including

an operation off the Azores. She will be away for two and a half months.

At Greenwich and at Ocean Works, Erith, His Royal Highness was shown the various processes of manufacture of the first transatlantic telephone cable which was inaugurated last September. The directors of Submarine Cables, Ltd., who were presented to the Duke were General Sir William Morgan (chairman of Siemens), Sir John Dean (chairman of Telcon), Mr. F. S. H. Lemon (joint managing director of Submarine Cables, Ltd.), Dr. J. N. Aldington (managing director of Siemens), Mr. G. W. Giffin (director of manufacture, Siemens), Mr. W. F. Randall (managing director, Telcon Metals Group) and Dr. E. W. Smith (managing director, Telcon Cables Group). Whilst at Erith His Royal Highness took the opportunity of visiting H.M.T.S. *Monarch* where he was received by Mr. Ernest Marples, M.P. (Postmaster General), Sir Gordon Radley (Director General, Post Office) and Captain J. P. F. Betson (commander of *Monarch*).

Women Engineering Workers' Wages

A woman delegate at the Amalgamated Engineering Union's annual women's conference on 13th March declared that while men's wages in the engineering industry were bad, the women were "treated even worse." Mrs. M. Candiotti, of Streatham, London, S.W., was proposing a resolution pressing for a wage for adult women workers of not less than the adult male labourers' rate. The resolution called on the national executive to instruct the executive council to hold a full-scale drive "and, if necessary, to issue a call for direct action." The resolution was carried with an agreed addendum stating that district committees should be encouraged to take necessary action to obtain the rate for the job for adult women workers whenever possible.

Power Station Workers Reject Offer

An offer to increase wages of power station employees by 1½d an hour was rejected by the employees' side of the National Joint Industrial Council for the Electricity Supply Industry at a meeting on 13th March. The men had claimed a "substantial" increase. The matter has been referred to the executive councils of the trade unions concerned and a further meeting of the N.J.I.C. is to be held on 27th March. The last increase, 4d an hour, was granted in February, 1956, and dated back to the beginning of the year.

Cable Company's Export Drive

The Sterling Cable Co., Ltd., is embarking on a special export drive in order to establish its products in European markets. Recently the first of a series of sales promotion meetings was held in Holland, where over ninety leading Dutch power engineers were given a demonstration of new jointing techniques for electric cables having aluminium conductors. Similar demonstrations are planned to take place in Denmark, Norway and Sweden.

General view of Stamford Bridge Stadium showing part of the new G.E.C. floodlighting system

Football Stadium Floodlighting Installation

A new £35,000 permanent floodlighting scheme—the largest stadium floodlighting installation in Britain—specially designed and supplied by the General Electric Co., Ltd., was inaugurated at Chelsea Football Club's ground at Stamford Bridge this week.

The 228 floodlights represent nearly half a million watts, and are mounted 170ft high on six tubular steel towers, among the highest to be installed in Britain for floodlighting a football ground. Special permission for their erection was obtained from the London County Council and the Town and Country Planning Authority. To avoid obstructing the view of spectators at daylight matches, and to allow for future extensions to the spectators' stands, the floodlights are situated at the back of the main terraces and behind the stands, and are consequently about 200ft from the edge of the playing area. High towers are necessary because of this abnormal offset distance.

One tower at each corner of the ground carries 30 G.E.C. F69057 symmetrical angle football field floodlights constructed of copper, and housing one "Osram" 1,500 W B.2 projector lamp or a G.L.S. angle burning lamp. The remaining two towers are each built at opposite sides of the centre line. Both towers carry 54 floodlights, comprising 48 G.E.C. F69057 1,500 W units, and six G.E.C. Z304 asymmetrical floodlights each housing one "Osram" 2 kW line filament lamp similar to those in use in the G.E.C. floodlighting installation at Wembley Stadium. The 216 symmetrical angle floodlights are divided into the following optical systems: 79 wide beams (rimpled mirrors with G.L.S. lamps); 108 medium beams (rimpled mirrors with G.L.S. lamps), and 29 narrow beams (plain mirrors with B.2 lamps).

The lamps will be over-run by about 10 per cent to provide an increase in light output of between 40 and 45 per cent. The total consumption, with the lamps in the over-run condition, would be 400 kW, but the total light output will be equivalent to a 480 kW loading at a normal voltage. The estimated average horizontal illumination at pitch level is 20/22 lm/sq ft. The architect for the installation was Mr. G. E. Skeats, A.R.I.B.A., Walton-on-Thames, and the electrical contractors were Pulver & Co., Ltd., Fitzroy Street, London, W.1. The towers were supplied by Tubewrights, Ltd., London, S.W.1, and erected by Clough Smith & Co., Ltd., Crawley, Sussex.

Gear Cutting Machines for France

The David Brown Companies Machine Tool Division, Manchester, has received what is claimed to be the largest order for two turbine gear cutting machines to be placed by a French company since the war, from the Cie Electro-Mécanique, of Le Bourget. One is an M.H. turbine gear hobbing machine, weighing over 100 tons, and capable of cutting gears up to 216in diameter. The second part of the order is for a P60 turbine pinion hobbing machine, designed for cutting pinions up to 60in diameter and 16ft in length.

Lighting Sales Conference

The sales staff of the "Atlas" Lighting Division of Thorn Electrical Industries, Ltd., and Ekco-Ensign Electric, Ltd., met recently at the Connaught Rooms, London, W.C.2, for a general sales conference to discuss current marketing conditions. The conference was presided over by Mr. J. G. Christopher, general sales

manager of "Atlas," and Mr. E. S. Evans, general sales manager of Ekco-Ensign. The meeting was addressed by Mr. Jules Thorn, chairman and managing director of Thorn Electrical Industries, Ltd.

"Pylon" Damage: Man Fined

At Feltham (Middlesex) Magistrates' Court on Monday, John Bryn Jones, the farmer's son who attempted to remove a tower on the Iver-Weybridge transmission line, appeared on a summons alleging "unlawful and malicious damage." The amount stated in the summons was over £1,282, but on the application of the prosecuting counsel this was amended to £693.

The defendant pleaded guilty but contested the amount put on the damage. He said that the whole of the damage was put right in three days.

His counsel said that the real trouble was the amount of compensation offered by the Central Electricity Authority for damage to the land, £155, when £330 had been claimed.

The Magistrates found Jones guilty and fined him £100, giving him a month in which to pay.

Dry Battery Manufacturers' Association

Following dissolution of the Association of Radio Battery Manufacturers at the end of February, a new body, the Association of Dry Battery Manufacturers, has been formed. The members are the Atlas Carbon & Battery Co., Ltd; Chloride Batteries, Ltd.; Ever Ready Co. (Gt. Britain), Ltd.; General Electric Co., Ltd.; Holsun Batteries, Ltd.; Oldham & Son, Ltd.; and Siemens Bros. & Co., Ltd.

The main objects of the Association will be to promote and encourage the manufacture and use of all kinds of dry batteries. It will also provide and be a central medium for dealing with any inquiries regarding the dry battery industry which may emanate from Government Departments, traders, the Press and the general public.

It will not have any jurisdiction over prices, terms and conditions of trade or any matters pertaining to distribution. These will be handled individually by the manufacturers concerned direct with their respective customers. A technical committee will deal with all matters concerning standardisation and its services will be available in an advisory capacity to equipment makers and the trade, if required. The Association offices are at 77, Bedford Court Mansions, Bedford Avenue, London, W.C.1 (telephone: Museum 0476), and the director and secretary is Mr. Hamish Kirkwood.

Lancashire Dynamo Nevelin Staff Canteen

A new staff canteen at the Oxted Works of Lancashire Dynamo Nevelin, Ltd., was formally opened by Mr. S. F. Steward, the Lancashire Dynamo Group managing director, before a large gathering of works personnel. In addition to its normal function as a canteen, the building will also serve as a centre for the Sports and Social Club, and to complement this aspect, the club chairman presented Mr. Steward and Mr. A. Newing (managing director at Oxted) with photograph albums containing illustrations of typical activities of the Club. The albums also included pictures showing the canteen site and depicting various stages of progress during building. The official opening was marked by a dance organised by the Sports and Social Club, and this was attended by some 200 people.

The new staff canteen of Lancashire Dynamo Nevelin, Ltd., at Oxted

Aden Broadcasting Service

The Aden Government has ordered two radio transmitters from Marconi's Wireless Telegraph Co., Ltd., for the Aden Broadcasting Service. The transmitters, a 7½ kW type BD.260, to serve the Protectorate, and a 5 kW type TBM.672, to serve the Colony, are due to come into service in the early summer.

Synthetic Rubber Symposium

The first International Conference on Synthetic Rubber to be held in Britain opens in London at Church House, Westminster, on Tuesday next. The President of the Board of Trade will officially open the meeting in his capacity as hon. president of the Symposium. The chairman of the Symposium is Mr. G. E. Beharrell (deputy chairman and managing director, Dunlop Rubber Co.). The conference will continue on Wednesday and Thursday.

Trade Announcements

The main project and estimating section of **Bailey Meters & Controls, Ltd.,** is moving on 25th March to Croydon, and with effect from to-day (Friday) all inquiries, orders and correspondence should be addressed to the company's Sales Department, Purley Way, Croydon, Surrey (telephone: Croydon 4191). A sales office is being maintained at Moorgate Hall, 153, Moorgate, London, E.C.2.

Mr. K. J. Trudgen, formerly a Midlands area representative of Brookhirst Switchgear, Ltd., has been appointed representative of the control gear division of **G.W.B. Furnaces, Ltd.,** for London and the Home Counties. The appointment will be effective as from the commencement of the Electrical Engineers Exhibition in April when Mr. Trudgen will be on the G.W.B. stand.

Mr. W. R. Robinson has been appointed representative for **Carron Company** in Northern Ireland.

The **Trix Electrical Co.** has acquired additional factory premises at Wish Road, Eastbourne, in order to expand the production of its range of sound reproducing equipment.

R. A. Poole, Ltd. (formerly R. A. Poole (London), Ltd.), radio and electrical wholesalers, are moving on 1st April to 26, Cambray Place, Cheltenham Spa, Glos. (telephone: Cheltenham 55311).

The **English Electric Co.'s** appliance and television service depot in Manchester has moved to 312, Deansgate, Manchester, 2. The telephone number (Blackfriars 8952) is unaltered. The company has appointed Mr. P. H. Thurley as sales representative with the appliance and television division. He will be based at the Leeds branch and will work in the Yorkshire Electricity Area and the York and Harrogate Sub-Areas of the North Eastern Board areas.

Adamson & Co. (Tyne), Ltd., electrical wholesalers, have opened larger premises at Darlington in King Street (telephone: Darlington 5285/6).

A. H. Hunt (Capacitors), Ltd., has appointed Henry H. Johnston & Co., 3, Mearns Road, Clarkston, Glasgow, as its agents in Scotland for capacitors for power factor improvement.

F. Westerman (Wholesale), Ltd., have been appointed wholesale distributors for Dexion, Ltd.

GENERATION AND DEVELOPMENT

Output in February

The monthly returns issued by the Ministry of Power show that 7,889 million kWh was generated by the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board in February, a decrease of 10·4 per cent compared with February, 1956, when weather conditions were more severe and there was an extra day due to Leap Year.

ELECTRICITY GENERATED AND SENT OUT FOR PUBLIC SUPPLY

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	3,709	75	10·9	7,161	19	7,187	6,753	22,494
North of Scotland H.E.B. ...	9	—	1·2	15	207	227	226	808
South of Scotland E.B.	226	6	0·1	435	40	475	452	1,368
Total for February, 1957 ...	3,944	81	12·2	7,611	266	*7,889	7,431	24,670
Corres. total for February, 1956	4,628	82	41·3	8,640	147	8,809	8,302	22,476
Inc. or dec., per cent	—14·8	—1·7	—70·4	—11·9	+81·2	—10·4	—10·5	+9·8
Total to date (2 months) 1957 ...	8,547	178	26·4	16,336	558	16,919	15,935	
Total for corres. 2 months of 1956	9,073	181	72·4	17,027	328	17,398	16,388	
Inc. or dec., per cent	—5·8	—1·8	—63·5	—4·1	+70·1	—2·8	—2·8	

* The total figure includes generation by other methods amounting to 12 million kWh.

No additional generating plant was installed during the month, at the end of which the total capacity was 24,670 MW, compared with 24,675 MW a month earlier.

In addition to electricity sent out for public supply, 839 million kWh was generated by industry in the four weeks ended 23rd February last, against 821 million kWh in the corresponding period of 1956, an increase of 2·2 per cent. The industries covered by this return do not include railways, transport undertakings, coal mines, gasworks or petroleum refineries.

Transformers for the Supergrid

One of three 120 MVA 275/132 kV transformers left the works of the Hackbridge & Hewittic Electric Co., Ltd., at Walton-on-Thames recently for its destination at West Weybridge. The second unit is shortly to be dispatched to the same site whilst the third is destined for Fleet, Hants. They are for interconnection between the Central Electricity Authority's new supergrid and the existing 132 kV system.

The transformers are star-auto wound and include an 11 kV delta-connected tertiary winding. On-load tap-changing gear is fitted to provided voltage variations of plus and minus 15 per cent in 18 equal steps, and the three switches are located at the 132 kV line position in the winding. The bushing terminals carry the three diverter switches, the housings of which are " alive " and form part of the 132 kV line bushing assembly. The first unit has successfully withstood impulse type tests at 1,050 kV at 1/50 microsecond full wave and 1,200 kV chopped wave on the 275 kV terminals, also 550 kV full wave and 630 kV chopped wave on the 132 kV terminals. The over-potential test was 450 kV on each 275 kV terminal to earth and 550 kV between 275 kV terminals. The full load efficiency is 99·5 per cent. For transport purposes the unit was dispatched without oil and under gas pressure but even so the transport weight was nearly 120 tons.

Revised Manx Tariffs

New tariffs are to be introduced by the Isle of Man Electricity Board with effect from 31st March. In place of the existing two-part domestic tariff with a fixed charge based on floor area or rateable value, the Board has adopted the " number of rooms " basis, and there will now be no fixed charge or surcharge. The primary rate of 7½d/kWh will apply to 40 kWh for premises with one to four assessable rooms and to an additional 10 kWh for each extra room up to ten. From eleven to twenty rooms 5 kWh will be added for each room and thereafter 10 kWh for every room. The secondary rate is 1½d/kWh. For prepayment supplies an extra ½d/kWh will be charged on the primary rate. Meter rents are 1s 6d a quarter and there is a minimum charge of 10s for each winter quarter and 5s for each summer quarter. Accounts are subject to a 2½ per cent cash discount on consumption at the secondary rate only.

In the case of commercial premises the primary block at 7½d will be fixed on an area basis, the follow-on rate being the same as under the domestic tariff. Industrial power will be charged for on a sliding scale from 3¼d to 1¼d/kWh according to consumption. No fuel clause is included but the tariff is subject to annual revision, and there is a minimum charge of £1 per quarter.

" Manweb " to Raise Primary Charges

The Merseyside and North Wales Electricity Board has announced that increased charges will come into operation from the end of this month, a recent review having confirmed that unless tariffs are raised there will be deficits in this and succeeding years. Since the last tariff changes in 1955 the annual costs of the Board have increased by £1,000,000.

The present proposals are to increase the primary price in the domestic, farm, and commercial and industrial block tariffs from 4½d to 5½d per kWh for consumers taking supplies through ordinary meters, and from 5d to 6d for supplies through prepayment meters; other rates in these tariffs will remain unchanged.

In the commercial and industrial maximum demand tariffs the kW charges are to be increased by 5s, the amount of the increase in the bulk supply tariff made last April which was not passed on to the consumers, and by a further 10s per kW; this,

A 120 MVA Hackbridge transformer en route to West Weybridge for the C.E.A.

however, is offset by a reduction in the "unit" price of 0·03d.

All these adjustments will increase the Board's revenue by just over £1,000,000, thereby covering the present known increased costs.

As far as the domestic tariff is concerned, this is the second increase in the Board's standard domestic tariff since it was introduced in October, 1951. At that time the charge to a consumer taking 400 kWh per quarter was £2 8s 3d; in 1955 it rose to £2 12s; and the result of the new increase will raise this to £2 18s per quarter, an increase of 20 per cent over the price ruling in 1951. It is pointed out that in the same period the materials in general use by the Board have increased by 47 per cent, salaries and wages by 38 per cent, and coal by 40 per cent.

Generating Plant Installed in 1956

Referring to the schedule of generating plant installed in 1956 by the North of Scotland Hydro-Electric Board in our issue of 1st February (page 219), the English Electric Co., Ltd., states that it supplied the 16 MW turbo-alternator set installed at the Ceannacroc power station and also the complete turbo-alternator set at the Invergarry power station.

New Power Station at Port Sunlight

The foundation stone of a new oil-fired power station which will cost £2 million and will supply steam and electricity to the factories of Unilever, Ltd., in Port Sunlight and Bromborough was laid in Port Sunlight on 13th March by Lord Heyworth, chairman of the company.

When the station is completed in about a year's time it will produce over a million tons of steam and nearly 80 million kWh annually. Operation of the station will result in a saving to the nation of approximately 213,000 tons of coal a year.

OVERSEAS

Zambesi Flooding

It is reported that the flooding of the Zambesi River has shut down the Victoria Falls power station at Livingstone, Rhodesia, the buildings of which are partly submerged. By Monday last the level of the river was more than 2ft above the previous maximum. At Kariba Gorge the 55ft high cofferdam inside which the first part of the wall of the dam is being built has been submerged. Sir Malcolm Barrow, Minister of Power of Rhodesia and Nyasaland, said it was possible that there might be some damage to the preliminary works along the river but they were not in the least apprehensive of danger to the underground power station, the entrance to the underground workings being too high above the river. The biggest problem might prove to be little more than the delay caused to the construction of the foundations of the dam wall.

Parliamentary Report

IN the House of Commons last week Mr. Hugh Gaitskell asked if the Government had definitely made up their minds not to join Euratom. If that was so, when would a statement be made? The contents of the Euratom treaty were known.

Mr. Maudling said the Government could not give any answer until the treaty was confirmed and some association of this country had been proposed by the Western European countries concerned.

Mr. Eric Fletcher asked the Paymaster General if he would arrange for the fullest exchange of technical information between this country and the United States with regard to the Calder Hall atomic power station and the American power station at Shippingport, respectively.

Mr. Maudling said the A.E.A. had already offered to give the United States Atomic Energy Commission detailed information on the Calder Hall power station in exchange for similar information on the power station under construction at Shippingport. The United States Atomic Energy Commission was considering this offer.

Mr. Maudling informed Mr. Hector Hughes there was no possibility of an explosion resembling that of an atomic weapon occurring as a result of accident or malicious damage to plant or laboratory equipment in any atomic energy establishment.

Clean Air Council

Replying to Mr. Moyle, Mr. Henry Brooke, Minister of Housing and Local Government, said that arrangements for the appointment of the Clean Air Council were in train and he hoped to announce its composition before long.

Electricity Supply Pensions

Mrs. Castle asked the Paymaster General whether the resolutions from the Central Electricity Authority and Area Boards amending their respective protected persons superannuation schemes had yet been approved.

Mr. Maudling replied that the Minister of Power had approved the resolutions in principle but had asked the Authority and the Boards to amend them in order to secure that the increases would be effective from 1st April, 1956.

Dame Irene Ward asked the Paymaster General whether he had now reconsidered his refusal to include ex-company pensioners in the recent pensions increase regulations.

Mr. Maudling replied that the Minister of Power, after further consideration, had informed the C.E.A. and the Gas Council that he was prepared to approve the comprehensive proposals put forward by the two industries.

School Laboratories

Mr. Eric Fletcher asked if the Government would take steps to encourage local authorities to expand the laboratory accommodation in all maintained schools in order to meet the increasing demands for sixth-form science teaching.

Sir E. Boyle said a great deal had already been done within the scope of post-war school building programmes. The Minister of Education intended to include in the 1957-58 and 1958-59 programmes more work than hitherto specifically designed to improve facilities in secondary schools for teaching science, especially in sixth forms.

Colleges of Advanced Technology

Sir Edward Boyle, replying to Mr. J. C. Jennings, said that eight technical colleges had now been designated as colleges of advanced technology. These were Birmingham College of Technology, Bradford Technical College, Cardiff College of Technology and Commerce, Loughborough College of Technology, the Royal Technical College, Salford, and, in London, the Battersea, Chelsea and Northampton Polytechnics.

Exploitation of Nigerian Gas

Mr. Sydney Irving asked the Secretary of State for the Colonies if the gas discovered at Akata in Eastern Nigeria would now be used for generating electricity to supply Aba and Port Harcourt; and to what extent the Government of Nigeria would participate in the exploitation and distribution of the gas.

Mr. Profumo, Under Secretary, Colonial Office, said these matters were being considered by the Federal Government, but no decisions had yet been made.

Restrictive Practices Court

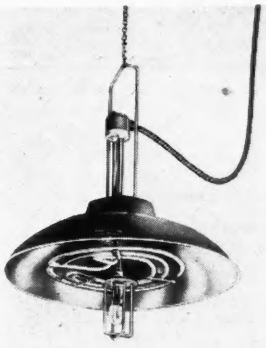
Sir R. Manningham - Buller, Attorney-General, informed Mr. Du Cann that he was not yet in a position to say when the first sittings of the Restrictive Practices Court would be held.

NEW ELECTRICAL EQUIPMENT

Dull-emitter Heater

The "Pyroflector 600" dull-emitter heater for pig and poultry breeding now available from the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2, is rated at 600 W and follows the general design of the company's smaller 300 W model. A terminal box is embodied in the 600 W unit and replaces the Edison screw holder of the 300 W heater.

It is supplied in two forms, one with a pilot light and protecting guard, and the other without. An even distribution of heat is obtained from the "Pyrobar" element, which is housed within a 15in diameter burnished aluminium reflector. The unit is supplied with 5ft of suspension

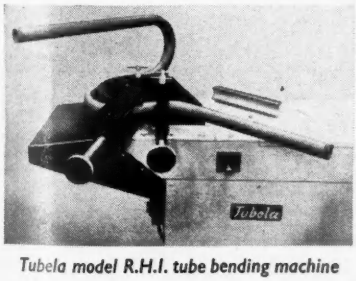


B.T.H. "Pyroflector 600" dull-emitter heater

chain, and 6ft of three-core rubber-covered cable at a cost of £6 10s. The price, with pilot light and guard, is £7 11s 3d.

Tube Bending Machine

A motorised rotary hydraulic tube bending machine, suitable for either left- or right-hand bending up to 180 deg, has recently been developed by



Tubela model R.H.I. tube bending machine

the TUBELA ENGINEERING CO., LTD., Fowler Road, Hainault, Essex.

It is powered by a ½ h.p. 400/440 V three-phase 50 c/s motor directly coupled to a multi-piston swash plate "Beacham" pump unit operating twin high-pressure double-acting ram units which provide a torque of 45·4in/tons.

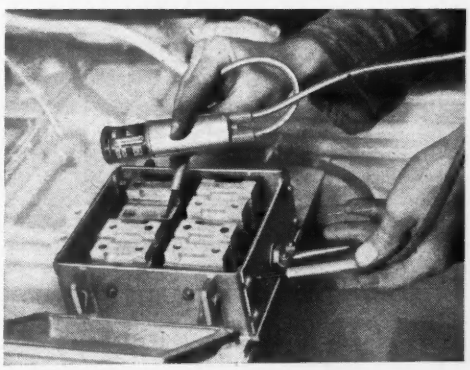
The machine is simply controlled from either side and is fitted with an automatic valve release to prevent over-travel of the bending arm. Its clear table surface offers unrestricted bending and is suitable for single or batch production runs. The overall length of the machine is 5ft 9in and the height 3ft 6in. It is 1ft 8in wide and weighs approximately 5 cwt. The price, ex works, is £395.

Voltage Tester

New test equipment manufactured by the MARTINDALE ELECTRIC CO., LTD., Westmorland Road, London, N.W.9, registers voltages up to 600 V by means of an indicating disc behind a built-in magnifier. The manufacturers claim that the instrument can be used with absolute safety. In addition to voltage readings the tester will also record whether the current is a.c. or d.c. and which point is earthed.

The prods have spring loaded sheaths, which can be kept back, if needed, by a bayonet clipping. Inside the prod is a 0·5 A h.r.c. fuse coupled in series with a 68 ohm current limiting fuse.

The body is made of high impact strength moulded plastic, which has high insulating properties and the bobbin is of moulded nylon and contains more than one mile of wire, thus



providing a low rating and a high resistance.

This instrument is supplied with a case so that it can be conveniently carried in the pocket or tool box.

Left : Martindale tester applied to a factory fuse-box

Dose Rate Controller

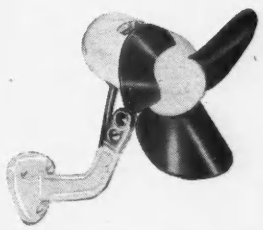
An electrically operated dose rate controller introduced by A. M. LOCK & CO., LTD., 79, Union Street, Oldham, Lancs., has been designed for use with Pye industrial pH measuring equipment for regulating the flow of reagent to a process or effluent so as to maintain the pH within required limits.

The output from the pH meter is fed into the controller which carries adjustable high and low limit switches. If the pH falls below or rises above the limits one of the two output relays on the controller is energised. This actuates a two-stage timer. The first time stage energises a reversible electric motor in the control valve to either increase or reduce the reagent flow. The motor operates for a preset time (0-30 seconds) depending on the process; at the end of this time, the timer switches off the motor for a time adjustable between 0 and 5 minutes.

If at the end of this "wait" period the pH has been restored to its required value no further action takes place until another deviation occurs. If, however, the pH is still outside its limit the cycle of events is repeated until the correct conditions are restored. This "wait" period allows for any time lags between the reagent addition and measuring points, and gives time for the reaction change to take place.

Vehicle Fan

A new vehicle and aircraft fan developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, has 6in diameter black rubber blades, is silent running and can be operated from the battery system of any vehicle. The motor is totally enclosed and mounted on a backplate by means of a ball and knuckle joint which provides an effective means of controlling the direction of air flow. The motor body and backplate are finished in white enamel and the joint is chromium plated. The fan has a speed of 2,500 r.p.m. and is suitable for 6, 12 or 24 V d.c. It is rated at 14 W and the weight is 1½ lb.



Above: G.E.C. 6in vehicle and aircraft fan

Fused Terminal Block

In a note under this heading in our issue of 15th February (p. 307) we stated that the new G.E.C. terminal block was fitted with a 2 A standard miniature cartridge type fuse. Actually a special fusible element is employed to provide adequate protection, coupled with freedom from random failures in the absence of fault conditions.

DOMESTIC ELECTRICAL EQUIPMENT

Vacuum Cleaners

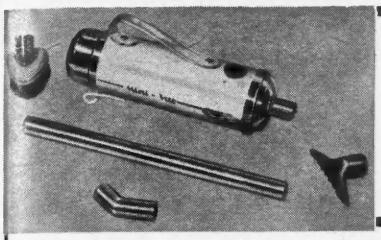
IN the following survey particulars are given of an item of domestic electrical equipment which is probably placed higher in the list of labour savers in the home than any other, namely, the vacuum cleaner. Two basic types are available: the cylinder model, with internal dust bag, and the upright, with external bag. If hand cleaners, the smaller portable types, are also taken into account there are in all well over sixty different models from which to choose.

For the average house where it is continually necessary to deal with staircases, walls, furniture, etc., the cylinder cleaner, because of its greater manœuvrability and additional accessories, will probably be favoured, but for the larger home where there may be considerable expanses of carpeting the upright or bag type cleaner is perhaps more suitable.

In general, the cylinder cleaner has greater suction power than its upright counterpart but by way of compensation the latter type is usually fitted with a motor-driven brush. Electricity consumption is not heavy as the motor is seldom rated higher than 300/350 W, exceptions being the " extra suction " models with a load in the region of 500 W. Universal motors are practically standard. The question of interference with radio and television has been tackled and many of the cleaners now sold are already " suppressed " or can be fitted with a suppressor at little extra cost.

Since we last reviewed vacuum cleaners one or two new models have appeared on the market, in particular the " Electrolux 62 " cylinder cleaner and the Hoover " Constellation," a spherical cleaner of revolutionary design.

Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
BRITISH VACUUM CLEANER & ENGINEERING CO., LTD., Goblin Works, Leatherhead, Surrey.	" Regal " G.38	Upright	250 W	Dust finder headlight, beater brush	Full set brushes and nozzles	Fawn enamel, red dust bag	£21 0 0 plus £3 13 6 (accessories)	£9 4 3 plus £0 14 3 (accessories)
	" Cleansweep " G. 531	Cylinder	300 W	For the small house	Full set brushes and nozzles	Silver grey, brown ends	£15 19 6	£7 0 2
	" Triumph " G.52	Cylinder	300 W	For the medium sized house	Full set brushes and nozzles	Steel blue, oriental blue ends	£19 19 0	£8 15 0
	" Ace " G.56	Cylinder	500 W	Powerful motor combined with quietness	Full set brushes and nozzles	Velvet grey stoved enamel, two-tone	£22 11 6	£9 18 1
BROWN BROTHERS, LTD., Great Eastern Street, London, E.C.2.	" Duco Junior " ECA 34/92 and ECA 34/117	Cylinder	230 W	—	Nozzle, oval brush and crevice tool	Rexine body, cast aluminium ends	£8 6 8 (ECA 34/92) £8 13 4 (ECA 34/117) suppressed	£3 12 2 (ECA 34/92) £3 15 1 (ECA 34/117) suppressed
	" Duco Super Silent " ECA 34/91 and ECA 34/116	Cylinder	230 W	Completely shrouded motor	Nozzle, triangular and oval brushes, crevice tool	Rexine body, chromium ends	£11 19 0 (ECA 34/91) £12 7 7 (ECA 34/116) suppressed	£5 3 6 (ECA 34/91) £5 7 4 (ECA 34/116) suppressed
	" Duco Blue-Riband " ECA 34/95 and ECA 34/115	Cylinder	230 W	Swivelled hose, recessed switch	Nozzle, triangular and oval brushes, crevice tool	Rexine body, cast ends	£10 6 5 (ECA 34/95) £10 13 4 (ECA 34/115) suppressed	£4 9 5 (ECA 34/95) £4 12 5 (ECA 34/115) suppressed
	" Duco Major " ECA 34/102 and ECA 34/118	Upright	275 W	Motor driven brush agitator, adjustable nozzle	Nozzle, oval brush, crevice tool, 2ft tube ext. and flexible hose	Maroon body and bag	£12 5 9 (ECA 34/102) plus £3 3 0 (accessories) £12 12 5 (ECA 34/118) suppressed	£5 6 5 (ECA 34/102) plus £0 13 7 (accessories) £5 9 4 (ECA 34/118) suppressed
	" Duco Standard " ECA 34/99 and ECA 34/120	Hand	150 W	Lightweight, all-rubber nozzle, incorp. brush	—	Maroon body and bag	£5 16 0 (ECA 34/99) £6 2 1 (ECA 34/120) suppressed	£2 10 2 (ECA 34/99) £2 12 11 (ECA 34/120) suppressed
	" Duco De-Luxe " ECA 34/100 and ECA 34/119	Hand	150 W	Detachable metal nozzle, 2ft tube extension	Ext. tube, furniture brush and crevice tool	Maroon body and bag	£6 9 4 (ECA 34/100) £6 15 9 (ECA 34/119) suppressed	£2 16 0 (ECA 34/100) £2 18 9 (ECA 34/119) suppressed
	" Duco Super " ECA 34/110	Hand	160 W	T.V. suppressed, slide action switch	Ext. tube, oval brush, nozzle and crevice tool	Maroon and blue-grey	£6 15 0	£2 18 6
BYLOCK ELECTRIC, LTD., South Street, Enfield, Middlesex.	" Centurion "	Cylinder	400 W	—	Full set brushes and nozzles	Oyster green hammered metal, chromium ends	£13 7 6 £13 17 6 (suppressed)	£5 17 6 £6 1 10 (suppressed)
	" Zephyr "	Cylinder	350 W	Switch in handle, skids replaced with four feet	Full set brushes and nozzles	Beige, Bakelite fittings	£11 12 6 (suppressed)	£5 2 2 (suppressed)



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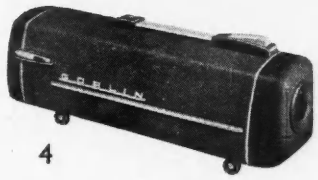

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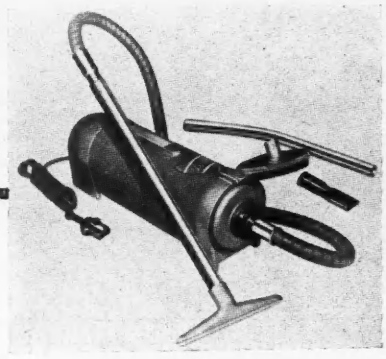

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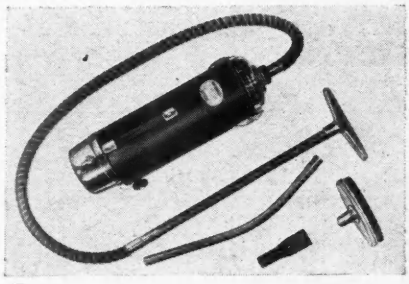
1. *Bylock "Mini-Vac" hand cleaner*
2. *Bylock "Zephyr"*
3. *B.V.C. "Regal" G.38 upright cleaner*
4. *B.V.C. "Ace" G.56 cylinder cleaner*
5. *Brown Brothers "Duco Blue Riband"*
6. *C.W.S. "Popular" upright model*
7. *Cadisch "Cadison"*
8. *Brown Brothers "Duco Super" hand cleaner*



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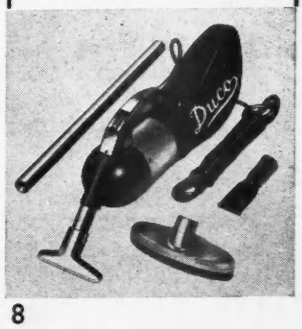

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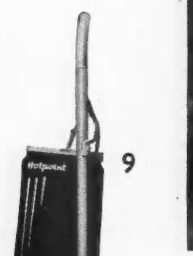
Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
BYLOCK ELECTRIC, LTD., South Street, Enfield, Middlesex. *(continued)*	"Classic"	Cylinder	300 W	—	Full set brushes and nozzles	Oyster green sprayed	£8 19 6 £9 9 6 (suppressed)	£3 18 8 £4 3 0 (suppressed)
	"Minivac"	Cylinder, hand	180 W	—	Carpet nozzle, dusting brush, ext. wand	Off-white enamel body, plated accessories	£7 5 0 (suppressed)	£3 3 7 (suppressed)
R. CADISCH & SONS, Red Lion Square, London, W.C.1.	"Cadison"	Cylinder	250 W	Swivel hose connection	Carpet nozzle, brush, crevice tool	Black diced leatherette, plated ends	£8 15 0	£3 18 8
	"Cadison" 1013	Hand	160 W	Fitted with hard rubber nozzle	—	Black crackle	£5 19 6	£2 13 9
	"Cadison" 1024	Hand	160 W	Lightweight, contemporary styled	Ext. tube, brush, metal nozzle, crevice tool	Two-tone grey, black bag	£6 15 0	£2 19 3
CO-OPERATIVE WHOLESALE SOCIETY, LTD., National Works, Hall Street, Dudley.	"Invincible" 6020	Cylinder	250 W	—	1 nozzle, 1 crevice tool, 2 brushes	Leatherette and chromium	£9 1 9	£4 1 10
	"Invincible" 6014	Cylinder	300 W	—	2 nozzles, crevice tool, 2 brushes	Leatherette and chromium	£12 8 0 £2 10 0 (accessories)	£5 11 7 £0 7 6 (accessories)
	"Popular"	Upright	220 W	—	Nozzle, brush, crevice tool, tube adaptor, ext. tube	Plastic handle, "Dimenso" base casting	£14 16 9 £4 0 0 (accessories)	£6 13 6 £0 16 10 (accessories)
	"Vac-Duster"	Hand	220 W	—	—	Black Bakelite	£7 6 9	£3 6 0

Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
ELECTRIX, LTD., Sterling Works, Dagenham, Essex.	"Silent Electrix" 270/161	Cylinder	350 W	Foot switch, screw-in hose, swivelled carpet nozzle, suppressed, up-the-stairs skids	Full set brushes and nozzles, and de-mother and spray gun	Black and chromium	£21 0 0	£8 3 10
	"Nu-Electrix"	Cylinder	350 W	Foot switch, screw-in hose, swivelled carpet nozzle, suppressed	Full set brushes and nozzles	Two shades of grey	£14 7 6	£5 12 2
	"Sterling"	Cylinder	350 W	Foot switch, screw-in hose, swivelled carpet nozzle, suppressed, up-the-stairs skids	Full set brushes and nozzles, and de-mother	Grey and maroon, chromium trim	£20 0 0	£7 16 0
	"SwiftClean"	Cylinder	350 W	Foot switch, screw-in hose, swivelled carpet nozzle, suppressed	Full set brushes and nozzles	Beige and maroon	£11 15 0	£4 11 8
ELECTROLUX, LTD., 153-5, Regent Street, London, W.1.	"Electrolux 62"	Cylinder	450 W	Increased mobility, throw-away dust bags, foot switch	Full set brushes and nozzles, sprayer	Light grey plastic covering, dark green ends	£23 0 0	£10 1 10
	"Electrolux 48"	Cylinder	300 W	Foot switch, air purification pad	Full set brushes and nozzles	Maroon "Pegamoid," black plastic ends	£17 0 0	£7 9 2
EXPRESS VACUUM CLEANER CO., 96, Bath Street, Birmingham, 4.	"Express"	Cylinder	200 W	Revolving brush in nozzle	Full set brushes and nozzles	Black rexine and chromium	£12 0 0	£5 8 0
FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.4.	"Cleanette" U.95737	Hand	160 W	Brush nozzle	—	Two-tone grey and black	£6 13 5	£2 18 7
	"Cleanette De-Luxe" U.95738	Hand	160 W	Swivelled carpet nozzle, curved ext. tube	Brushes, nozzles, crevice tool and tubes	Two-tone grey and black	£8 2 8	£3 11 4
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.	"DM.310A"	Cylinder	330 W	Double insulated. Suppressed for radio and T.V.	Full set brushes and nozzles	Grey and maroon	£15 15 0	£6 18 2



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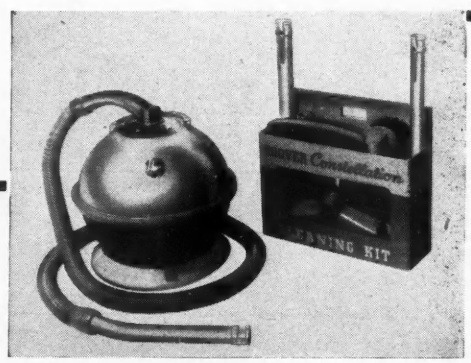

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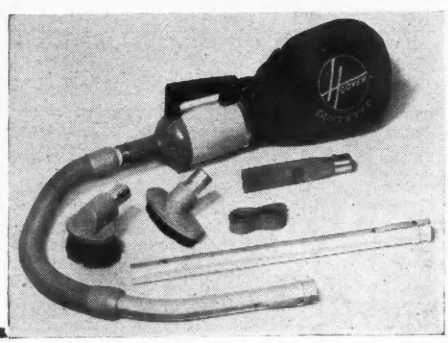

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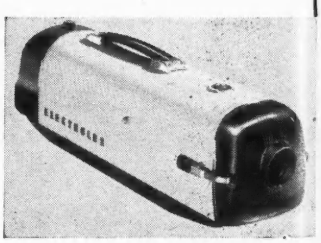
9. *Hotpoint model "420" cleaner*
10. *Electrix "Sterling"*
11. *Hoover "Constellation" spherical cleaner*
12. *Hoover "Dustette" fitted with "Hooverflex" hose*
13. *Electrolux model "62"*

13



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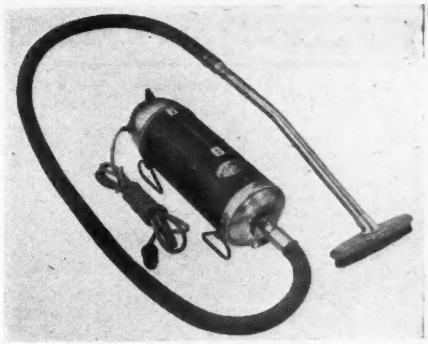

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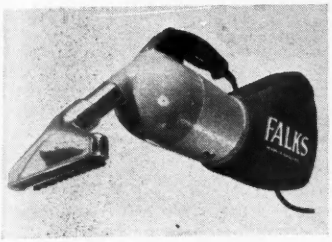

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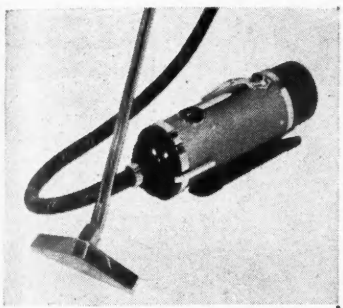
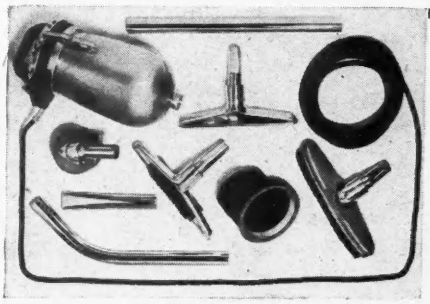
14. *Falk, Stadelmann "Cleanette" hand cleaner*
15. *Express Vacuum Cleaner Co.'s "Express"*
16. *Nash "Quikavac" upright cleaner*
17. *G.E.C. "DM.380" upright model*

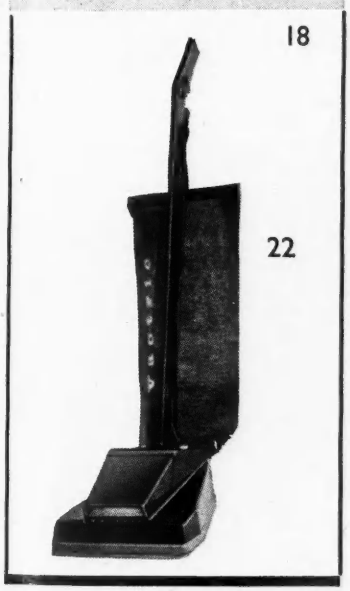
Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2. *(continued)*	"DM.380"	Upright	150 W	Double insulated. Suppressed for radio and T.V.	Full set brushes and nozzles	Grey and maroon	£15 15 0 £3 0 0 (accessories)	£6 18 2 £0 13 2 (accessories)
GENWIND, New Trading Estate, Lode Lane, Solihull, Birmingham.	Genwind "One-Hand"	Hand	100 W	Lightweight	—	Black crackle and chromium	£6 10 0	£2 8 9
HOOVER, LTD., Perivale, Greenford, Middlesex.	"638"	Upright	325 W	"Disposall" dust bag. "Dirt-finder" light. "Hooverflex" double-stretch hose	Full set brushes and nozzles	Blue plastic, grey metal	£24 17 6 £5 5 0 (accessories)	£11 3 11 £0 14 8 (accessories)
	"1224" Junior	Upright	200 W	"Hooverflex" double-stretch hose	Full set brushes and nozzles	Wedgewood blue and sandlewood beige, red emblems and foot switch	£19 12 0 £3 10 0 (accessories)	£8 16 5 £0 13 0 (accessories)
	"912" Heavy-duty	Upright	400 W	"Dirt-finder" light	—	Black and grey metal	£25 15 0	£11 11 9
	"417C"	Cylinder	510 W	—	Full set brushes and nozzles	Light blue and beige	£15 0 0	£6 15 0
	"Dustette" 2614	Hand	140 W	Shoulder strap. "Disposall" dust bag. "Hooverflex" double-stretch hose	Hose, ext. tube, 2 brushes and crevice nozzle	Blue bag, grey metal	£11 9 0	£5 3 1
	"Dustette" 2504	Hand	140 W	—	All-purpose cleaning brush	Blue bag, grey metal	£9 9 0	£4 5 1
	"Constellation" 822	Spherical	510 W	"Disposall" dust bag. "Hooverflex" double-stretch hose, swivels through 360 deg	Hose, ext. tube, 4 brushes and crevice nozzle	Light and dark blue and grey, red emblems and foot switch	£23 2 0	£10 7 11
HOTPOINT ELECTRIC APPLIANCE CO., LTD., Crown House, Aldwych, London, W.C.2.	"420"	Upright	250 W	Patented inner air-sleeve, foot operated switch	Full set brushes and nozzles	Grey stoved enamel, maroon bag	£18 4 10 £3 11 1 (accessories)	£8 0 2 £0 12 11 (accessories)
NASH ELECTRICAL CO., LTD., 82, Snow Hill, Birmingham, 4.	"Quikavac"	Upright	140 W	Lightweight	Full set brushes and nozzles	Various colours	£12 0 0	£5 8 0

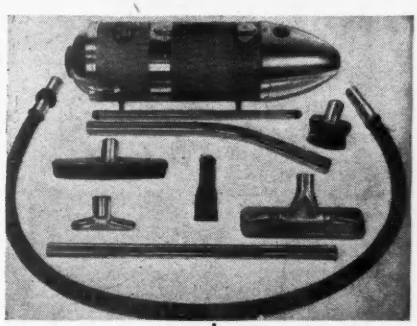
Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
PHŒNIX SALES, LTD., Winton House, St. Andrew Street, London, E.C.4.	"Popular"	Cylinder	230 W	—	Full set brushes and nozzles	Leatherette body, nickel ends	£8 6 7	£3 15 0
	"Gloria"	Cylinder	230 W	—	Full set brushes and nozzles	Leatherette body, nickel ends	£9 2 0	£4 1 11
	"Major"	Cylinder	230 W	—	Full set brushes and nozzles	Brown leatherette body, chromium ends	£10 3 4	£4 11 6
	"Clipper"	Cylinder	230 W	—	Full set brushes and nozzles	Leatherette body, Bakelite insets, chromium ends	£10 18 0	£4 18 1
	"Jet Power"	Cylinder	480 W	Extra power and suction	Full set brushes and nozzles	Blue body, chromium ends	£12 19 8	£5 16 10
	"Power Flo"	Cylinder (Box)	480 W	Extra power and suction	Full set brushes and nozzles	Grey body, maroon Bakelite ends	£12 19 8	£5 16 10
SIROMA ENGINEERING CO., LTD., North Acton Road, Harlesden, N.W.10.	"Siroma" 1022	Hand	160 W	Slide action switch, simple dust bag release, T.V. suppressed	Ext. tube, brush, nozzle, crevice tool	Stoved enamelled mist blue and brown	£6 15 0	£2 19 3
	OB1020	Upright	275 W	Slide action switch. T.V. suppressed	Full set brushes and nozzles	Stoved enamelled biscuit and brown	£12 10 0 £2 18 4 (accessories)	£5 9 8 £0 12 10 (accessories)
SLOAN ELECTRICAL CO., LTD., 31-33, Bondway, Vauxhall, S.W.8.	"Summit"	Cylinder	250 W	Foot switch, T.V. suppressed	Full set brushes and nozzles	Light brown leathercloth, chromium fitments	£9 3 8	£3 19 7
	"Summit"	Hand	160 W	Quick release bag, T.V. suppressed	Ext. tube, brush and 2 nozzles	Cream and brown	£6 19 6	£3 1 2
	"Summit"	Upright	275 W	Slide action switch, T.V. suppressed	Full set brushes and nozzles	Cream handle, brown bag	£12 6 8 £2 19 8 (accessories)	£5 11 2 £0 13 1 (accessories)
	"Super Summit"	Cylinder	350 W	Tubular runners, foot switch, 3-stage impeller, T.V. suppressed	Full set brushes and nozzles	Light brown leathercloth, chromium fitments	£13 10 0	£5 17 0
ALBERT TAYLOR (MANCHESTER), LTD., Quay Street, Manchester, 3.	"Compet Major"	Upright	230 W	—	Full set brushes and nozzles	Grey anodised, black bag	£12 10 0 £2 17 6 (accessories)	£5 10 0 £1 5 3 (accessories)
	"Compet Senior"	Cylinder	230 W	Swivelled hose	Full set brushes and nozzles	Leatherette body, chromium ends	£12 0 0	£5 5 6
	"Compet Junior"	Cylinder	230 W	—	1 brush, 2 nozzles	Leatherette body, polished metal ends	£8 15 6	£3 17 3
	"Compet Handy"	Hand	160 W	Lightweight	1 brush, 2 nozzles	Two-tone grey, black bag	£6 15 0	£2 19 3
TELLUS SUPER VACUUM CLEANER, LTD., 39, Sheen Lane, Mortlake, S.W.14.	"R.40"	Canister	200 W	Hygienic metal dust container	Full set brushes and nozzles	Polished aluminium	£22 10 0	£10 4 0
	"S.59"	Canister	450 W	Hygienic metal dust container	Full set brushes and nozzles	Polished aluminium	£27 6 0	£12 7 6
VACTRIC, LTD., 196, Sloane Street, London, S.W.1.	"W.202"	Cylinder	400 W	Swivelled nozzle	Full set brushes and nozzles	Brown with fawn rexine body, aluminium ends	£21 5 0	£8 3 8
	"R.56"	Upright	210 W	Double dust bag, shadow light, moulded brushes with nylon bristles	Full set brushes and nozzles	Mustard coloured bag, moulded body	£18 18 0	£7 5 7
	"Hand Duster"	Hand	160 W	Lightweight	Ext. tube, 2 nozzles and brush	Maroon bag	£8 5 0	£3 3 7
VACUUMS, LTD., Aldridge Road, Birmingham, 22B.	"Bustler"	Upright	130 W	Lightweight	Full set brushes and nozzles	Primrose enamel	£13 5 9 £2 19 4 (accessories)	£5 15 2 £0 9 0 (accessories)

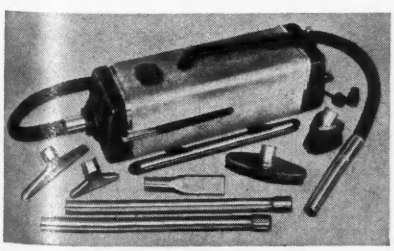
Manufacturer	Name or Model	Type	Motor	Special Features	Accessories	Finish	Price (excl. tax)	Purchase Tax
WATER SOFTENER & VACUUM CLEANER SERVICE, LTD., 248, Romford Road, Forest Gate, E.7.	"Jifextra"	Hand	180 W	Dual purpose floor cleaner and "Vacette"	Full set brushes and nozzles	Crackle stoved enamel, chromium and polished aluminium	£11 11 0	£5 4 0
WHOLESALE FITTINGS CO., LTD., 46-52, Commercial Street, London, E.1.	"Alto-Bag"	Upright	275 W	T.V. suppressed, revolving brush	Brush, nozzle and crevice tool	Cream	£13 6 8 £2 18 4 (accessories)	£5 17 0 £0 12 9 (accessories)
	"Alto-Vac"	Cylinder	250 W	T.V. suppressed	Full set brushes and nozzles	Maroon	£9 6 8	£4 1 11
	"Alto Hand Cleaner"	Hand	160 W	T.V. suppressed	Ext. tube, brush, nozzle and crevice tool	Two-tone grey	£6 15 0	£2 19 3

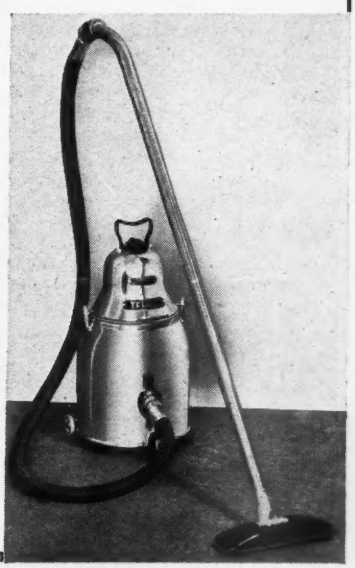












18. *Vactric "W.202" cylinder cleaner*
19. *Water Softener's "Jifextra"*
20. *Vacuums "Bustler" upright cleaner*
21. *Wholesale Fittings Co.'s "Alto-Bag" upright cleaner*
22. *Vactric "R.56" upright cleaner*
23. *Sloan "Super Summit" cylinder cleaner*
24. *Phœnix "Power-Flo" box-cylinder model*
25. *Siroma model OB.1020 upright model*
26. *Tellus "S.59" canister cleaner*

Financial Section

STOCKS and SHARES

THE shipyard and engineering labour troubles arose at a time when Stock Exchange markets were already tending to sag under the weight of successive capital issues, the latest of these being the offer of 40 million Steel Company of Wales £1 shares, in which dealings started at a discount. Once again, however, a critical situation failed to provoke the selling of securities on any serious scale. At the beginning of this week quotations were being marked down in most sections, but the principal effect had been to drive investors back into their shells. In the gilt-edged market, eyes went to the sterling exchange rates for signs of foreign reactions to this latest threat to Britain's trade and reserves. Prices of Government stocks receded fairly sharply. Industrials were of course affected mainly in the sections most directly concerned with the disputes. In the group of "atomic power" shares there were general falls of about half-a-crown. Declines of 6d to 1s occurred plentifully elsewhere in the electrical lists.

English Electric Earnings

Shareholders of English Electric were told by Sir George Nelson at the annual meeting that the group's turnover rose in 1956 by about £10 million, and that orders on hand at the start of this year amounted in value to £180 million. In referring to the increase in earnings and in the dividend, from 12½ to 14 per cent, the chairman pointed out that the new rate represented only about 5 per cent on the total capital invested in the business. His analysis showing where the group's income goes puts the dividend further into perspective and illustrates the smallness of the margin earned on turnover. Of every £100 received last year, approximately 47·5 per cent went in materials, 33·1 per cent in wages and salaries, 14·7 per cent in depreciation, maintenance, etc., and interest. Of the remaining 4·7 per cent, taxation took just about half, leaving 1·3 per cent retained in the business and less than 1 per cent for distribution in dividends.

Decca New Shares

Payment in full for the 1·4 million new Decca Record 4s "A" shares, offered to the company's stockholders at 22s 6d, fell due to-day (Friday). Selling of the "rights" diminished with the approach of this date, but the premium declined under general influences to less than 5s. Shares will continue to be transferable free of stamp duty for a few more days and, at an all-in price of 27s 6d, offer a yield of close on 6½ per cent on the dividend of not less than 43¾ per cent (the present rate) which the directors expect to be able to recommend, on the increased capital, for the year ending this month. In the first three-quarters of this period, turnover is stated to have exceeded by 30 per cent the corresponding figure for the previous year. The report includes a history of the company's growth under

Price Changes in

Company or Board	Nom. Value	Middle price 18th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	77½	—1	3	3	3 17 6	80	75
Brit. Elec. 1974/77	100	75½	—1	3	3	3 19 6	78½	73½
Brit. Elec. 1976/79	100	80½	—1	3½	3½	4 7 0	81½	77½
Brit. Elec. 1974/79	100	90½		4½	4½	4 14 0	92½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	6 9 9†	19/-	18/3
East African Power	£1	20/-		7	7	7 0 0	20/6	19/3
Nigerian Elec.	£1	17/6		10	10*	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	14/9		10	10*	13 11 3	14/9	13/3
Equipment and Manufacturing								
Aberdare Cables	5/-	11/-	—3d	17½	17½	7 19 0	11/3	9/9
Aerialite	1/-	5/9		45	48	8 7 0	6/-	4/9
Allen, W. H.	£1	40/-	+1/9	20	10*	5 0 0	40/-	33/6
Aron Elec. Ord.	£1	56/3		15	15	5 6 9	55/6	53/6
Assd. Automation	10/-	19/6	—9d	10	5	2 11 3	20/9	17/9
Assoc. Elec. Ord.	£1	62/6x.d.	—2/6	15	15	4 16 0	73/-	62/6
Automatic Tel. & El.	£1	57/6	—1/3	15	15	5 4 3	60/-	54/6
Babcox & Wilcox	£1	76/3	—3/9	15	15	3 18 9	82/6	71/6
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	4/-
Bakelite	10/-	20/6	—9d	16	15	7 6 3	21/9	20/9
Berry's Electric	5/-	5/9		—	10‡	8 14 0	5/9	5/6
British Aluminium	£1	67/6		12	12	3 11 0	70/6	63/9
B.I. Callender's	£1	49/6	—9d	10	12½	5 1 0	51/6	48/3
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	21/9	20/6
British Tabulating	£1	49/6		9	9	3 12 0	50/-	42/-
British Thermostat	5/-	27/-	—6d	20	25	4 12 6	27/6	25/9
British Vac. Cleaner	5/-	7/-		30	15*	10 14 3	8/-	6/6
Brook Motors	10/-	31/3		25	25	8 0 0	33/3	30/-
Brush Group	5/-	4/9	—9d	10	Nil	Nil	6/3	4/6
Bulgin, A. F.	1/-	5/3	—3d	50	40*	7 12 6	5/6	4/6
Burco Dean	5/-	11/-	—3d	22½	20	9 1 9	11/3	8/9
Chloride El. Storage "A"	£1	66/3	—9d	17½	17½	5 5 9	68/-	58/-
Clarke Chapman	£1	145/-x.d.		22½	27½	3 15 9	7¼	6¼
Cole, E. K.	5/-	18/6x.d.		17½	17½	4 14 6	19/6	16/6
Cossor, A. C.	5/-	6/3	—3d	15	Nil	Nil	7/3	5/9
Crabtree	10/-	25/-		20	20	8 0 0	25/6	23/3
Crompton Parkinson Ord.	5/-	16/3		16	16	4 18 6	17/9	14/6
De La Rue	5/-	18/-	—3d	30	30	8 6 9	19/9	16/3
Decca "A"	4/-	27/6	+6d	43¾	43¾	6 7 3	32/3	27/-
Desoutter	5/-	29/6		30	32½	5 10 3	29/-	27/6
Dewhurst	2/-	6/9		30	16¼*	4 16 3	7/6	5/9
Dictograph Tel.	2/-	7/6		20	20	5 6 9	7/6	6/9
Dubilier Condenser	1/-	5/3		25	30	5 14 3	5/9	5/6
Duport	5/-	18/9		23	25	6 13 3	19/6	17/6
E.M.I.	10/-	28/9	+1/-	15	15	5 4 3	29/6	23/9
Electrical Components	5/-	7/3		25	25	8 12 6*	7/3	6/6
Elec. Construction	£1	25/-		8½	8½	6 16 0	25/6	21/9
Elliott Bros.	5/-	27/6		17½	20‡	3 12 9	29/-	26/3
Enfield Cable Ord.	£1	16/3		Nil	Nil	Nil	21/6	13/-
English Electric	£1	56/3	—2/6	12½	14	4 19 6	58/9	47/6
English Electric 3¾% Pref.	£1	13/6		3¾	3¾	5 11 0	14/3	13/3
Ericsson Tel.	5/-	38/-x.d.	—2/-	20†	22†	2 18 0†	41/-	33/3
Ever Ready	5/-	30/9		35	35	5 13 9	31/9	30/-
Falk Stadelmann	£1	38/6		17½	17½	9 1 9	38/6	35/-
G.E.C. Ord.	£1	53/9	—2/6	12½	14	5 4 0	57/9	48/9
G.E.C. 6½% Pref.	£1	23/-		6½	6½	5 13 0	23/6	22/-
General Cables	5/-	12/3	—6d	30	30	12 4 9	13/6	11/6
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	46/3	45/3
Hackbridge Holdings	5/-	19/9	—6d	25	30	7 12 0	21/-	19/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	16/-	13/6
Heatrae	2/-	4/-		15	15	7 10 0	4/-	4/-
Henley's	10/-	16/9	—3d	10½	11½	6 17 3	17/-	15/3
Holophane	5/-	23/-		30	30	6 10 6	26/3	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

the guidance of Mr. E. R. Lewis, who is now to take the chair.

Brush Results

Shareholders of Brush Engineering had been warned of deterioration in 1956 through the passing of the interim dividend last November, but the company's decision to make no final distribution apparently caused some disappointment, reflected in a fall of 9d, to 4s 9d, in the price of the 5s shares. For the previous year, 10 per cent was paid. Although sales during the year expanded by almost £400,000, costs rose by more than twice as much. Interest charges also increased, and the net result, after tax, was a reduction in the profit from £480,000 to £174,000. Regarding this year's prospects, an accompanying statement reports that more orders were received in 1956 than in the previous year, and that there is an improvement in the balance of the order book.

Electrical Investments

Company or Board	Nom. Value	Middle price 18th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	33/-x.d.	—3d	50	50	7 11 6	34/-	24/9
I.C.I.	£1	40/6		10	10	4 18 9	43/9	37/9
Intl. Combustion	5/-	25/-		20	22½	4 10 0	25/-	20/-
Johnson & Phillips	£1	28/9	—1/3	15	15	10 8 9	34/6	28/6
Lancashire Dynamo	£1	42/6	—1/3	15	11*	5 3 6	45/-	36/9
Laurence, Scott	5/-	17/3	+6d	12½	15	4 7 0	17/3	13/9
Lister, R. A.	£1	28/9	—1/3	9·3	10	6 19 3	30/6	26/9
London Elec. Wire	£1	53/-	+1/-	12½	12½	4 14 3	53/-	43/-
Lucas, J.	£1	32/6	—9d	7½	7½	4 12 3	33/9	30/6
Marryat & Scott	2/-	9/3	—3d	30	30	6 9 9	9/6	8/-
Mather & Platt	£1	56/-	+2/6	15	15	5 7 3	56/-	51/3
Metal Industries	£1	23/9		9	Nil	—	25/-	20/3
Midland Elec. Mfg.	£1	47/6x.d.	+2/6	12½	12½	5 5 3	47/6	45/-
Morphy-Richards	4/-	13/9x.d.		50	50	5 16 3*	14/-	11/9
Murex	£1	69/-	—1/-	20	20	5 16 0	71/6	65/-
Newman Ind.	2/-	2/6	+3d	10	10	8 0 0	2/6	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	2/6	2/3
Parnall (Yate)	5/-	7/6	—3d	14	12	8 0 0	8/-	5/9
Parsons, C. A.	£1	63/9	—2/6	10	10	—	66/3	50/6
Plessey	10/-	72/6	—2/9	27½	30	4 2 9	76/3	61/-
Pye "A" Deferred	5 -	16/9	—3d	12½	12½	3 14 9	18/3	15/9
Reyrolle	£1	105/-	—1/3	15	16½	3 2 0	107/6	90/-
Rheostatic	4/-	10/-		18½	12½	5 0 0	10/-	8/9
Richardsons Westgarth	5/-	17/9	—1/-	16⅝	16⅝	4 14 0	19/-	17/-
Scottish Cables	4/-	18/3	—1/-	27½	27½	6 0 6	19/3	15/-
Smith (England), S.	4/-	14/6	—3d	17½	17½	4 16 6	14/6	13/-
Southern Areas	£1	17/6		10	7½	8 11 6	20/-	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/-	7/3
Sturtevant	5/-	26/-		14·4†	15†	2 17 9†	26/-	24/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	15/-	—6d	20	25	8 6 9	15/6	13/6
Taylor Tunnicliff	5/-	13/-x.d.	+6d	15	15	5 15 6	13/9	11/9
T.C.C.	10/-	38/9		25	25	6 9 0	38/9	35/-
T.C. & M.	£1	29/6	—6d	8½	8½	5 15 3	31/-	24/6
Telephone Mfg.	5/-	6/9	—3d	10	10*	7 8 3	7/-	6/3
Thorn Elec.	5/-	18/9		15	15	4 0 0	19/6	16/3
Thornycroft	£1	35/-	—1/3	15	12½	7 2 9	36/3	32/9
Tube Investments	£1	57/6	—9d	22½	15*‡	5 4 3	62/-	58·3
Vactric	5/-	15/-		15	17½*	5 16 9	15/-	12 9
Veritys	5/-	8/9	—6d	12½	12½	7 2 9	9/3	8/9
Walsall Conduits	4/-	13/3		70	20*	6 0 9	13/3	11/-
Ward & Goldstone	5/-	43/3		30	35	4 1 0	43/3	36/9
Watford	2/-	6/6		25	25	7 13 9	6/6	6/3
Westinghouse	£1	80/-		18	18	4 10 0	82/6	72/-
West, Allen	5/-	13/3	—6d	15	15	5 13 3	14/3	12/3
Wolf Electric	5/-	17/6		20	20	5 14 3	18/-	17/3
Trusts, Transport and Communications								
Anglo-Portuguese	£1	23/9	+6d	8	8	6 14 9	23/9	20/6
Brit. Elec. Traction: Def. Ord. "A"	5/-	20/6	+6d	22½	22½	5 9 9	20/9	17/-
Cable & Wireless: Ord.	5/-	11/-	—6d	10	10	4 11 0	12/-	9/6
4% Loan	100	92½		4	4	4 6 6	92½	89
Calcutta Trams	£1	25/9		75†	8½†	6 12 0†	26/6	22/9
Cape Elec. Trams	£1	15/6		8	8	10 6 6	15/9	14/6
Marconi Marine	£1	33/6		10	10	5 19 6	33/6	31/-
Oriental Tel. Ord.	1/-	74/6	—1/-	16	—	—	77/6	66/6
Telephone Rentals	5/-	11/-		12½	12½	5 13 9	11/3	10/3

Domestic Equipment

Shares connected with the production of domestic appliances have staged a considerable recovery from the depression induced last year by the tightening of the credit squeeze in the shape of the hire-purchase and purchase-tax regulations. Signs of a general revival of business have not been lacking. The recently issued annual report of Hoover, Ltd. (whose sales of washing machines are now much larger than those of cleaners) showed a 27 per cent fall in profits, but the results considerably exceeded expectations based on the earlier report of conditions half way through the year, thanks mainly to improvement in the export trade. A half-yearly statement from Morphy-Richards, covering the half year to last December, reported increased sales both at home and abroad, and a maintenance of profit margins.

Between the end of last year and the middle of this month, Hoover 5s shares had picked up from 24s to 34s, and Morphy-Richards 4s shares from 11s to 14s, while most other investments in the field were showing marked improvements. Prices have since been reactionary.

Reduced Dividends

In addition to the Brush Engineering announcement, recent company news has included declarations of reduced dividends from Pressed Steel and Bakelite. In both cases, notice of difficult trading conditions had been given during the course of the year for which the results are now published.

The Pressed Steel Company had already reduced the interim dividend for 1956, referring at the time to the effect upon profits of rising costs and the motor industry's recession. The company now declares a final payment making a total of 15 per cent, against 22½ per cent previously. Net profits are down from £958,000 to £713,000, and cover the distribution 2¾ times over. Stockholders are to be offered a £2 million issue of debenture stock carrying rights of conversion into ordinary shares. With the company's net profit reduced by about one-third despite maintained turnover, the Bakelite dividend is being lowered by a point to a total of 15 per cent. On the new rates of dividend, Pressed Steel 5s shares at 13s 9d yield 5·4 per cent, and Bakelite 10s shares at 20s 3d, about 7·3 per cent.

REPORTS and DIVIDENDS

The English Electric Co., Ltd.—The annual meeting was held on 14th March, Sir George Nelson, Bt. (chairman), presiding. In the course of his speech, the chairman said that the operations of the group in the year under review, although difficult, had contributed substantially to the economy of the country. The orders remaining in hand at the end of the year were £180 million for the companies in the group in Great Britain and there was adequate productive capacity to fulfil them by the due delivery dates.

Referring to their education and training resources, Sir George said that their achievements owed much to the steps they had taken over the years to encourage, train and give opportunities to young men of ability. They had spent immense sums on education inside their organisation and had supported school and university engineering departments with bursaries and subscriptions and the loan of specialists as lecturers.

With regard to exports, the highly competitive character of the heavy engineering business made it difficult to obtain orders on a reasonable profit basis. Notwithstanding these difficulties they had appreciably increased their orders and had also shipped equipment of greater tonnage overseas than ever before in any one year. Their business had come from 137 different countries. During the year they had increased their manufacturing facilities in Canada, South Africa and Australia, and initiated the establishment of such facilities in India.

Referring to the integration of European trade, Sir George said that the plan could not work satisfactorily if any of the countries adhering to the proposed free trade area should adopt or continue practices of open or concealed subsidy or differential export pricing amounting to dumping. Many difficulties and inequalities had to be overcome.

Dealing with the investigations of the Monopolies Commission, and the various price agreements which had been in operation for more than twenty years, he said that many recalled the chaotic conditions which prevailed over the years before such agreements existed, and it was well known how the industry had progressed during the past twenty years and what it had contributed to the economy of the country as evidenced by the fact that to-day it was the biggest exporting industry of Great Britain. They were concerned lest changes in a proved system might endanger employment in the industry. During the year they had spent vast sums on research and development.

Sir George referred to the arrangements concluded with the L.C.C. for the erection of a new building on the Gaiety Theatre site, which would form the integrated head office for the staff of the English Electric group.

In his survey of some of the principal activities of the group in the past year, Sir George said that the output of steam turbines and their associated alternators from the Rugby and Stafford Works represented an increase of some 12 per cent over the previous year. 480,000 kW of generating plant for the Central Electricity Authority was commissioned by the company, and orders placed by the Authority included five 120,000 kW and five 200,000 kW turbo-alternator sets; the development of much larger sets had been going ahead steadily during the year. In the export field they had received an order for the first two 100,000 kW turbo-alternator sets for installation in Australia.

Negotiations were proceeding satisfactorily between the C.E.A. and the English Electric Co., Babcock & Wilcox, Taylor Woodrow Group for the construction of a nuclear power station in Somerset. The output of traction equipment had been increased and they had shipped diesel-electric shunters, diesel-electric train equipments and electric multiple unit train equipments to the British Railways, diesel-electric locomotives to Rhodesia, Jamaica, New Zealand, Argentina and the Netherlands, and electric traction equipment to Australia and India. They had received substantial orders from the British Railways, but their capacity was by no means fully occupied.

In the field of hydro-electric installations a particularly important order was for the hydro-electric generating plant and transformers for the Grant County Administration, State of Washington, to the value of approximately $25 million. The most interesting hydro-electric project completed during the year was the commissioning of the first of four machines for the Bersimis-Lac Casse Project of the Quebec Hydro-Electric Commission. This machine developed 190,000 h.p. A further order from the Aluminum Co. of Canada, Ltd., was for five 200,000 h.p. sets.

The production and sales of diesel and dual fuel engines had been maintained satisfactorily during the year for a wide range of applications in both home and export markets.

Research and development work on the phenomena associated with the ever-increasing voltages required on power transmission systems resulted in the first order placed in this country for transformers operating at 330,000 V. This installation, comprising two 162,000 kVA 3-phase banks, was entrusted to them by the Electricity Commission of New South Wales and would feed energy from the Snowy Mountains scheme into the Sydney power distribution network. Another order for 330,000 V transformers was also received from the Central African Federation for the Kariba Gorge scheme involving three 240,000 kVA 3-phase banks.

The past year had been a record one for airblast and metalclad switchgear activity. In Canada they commissioned eighteen 138,000 V 5,000 MVA airblast circuit-breakers in the Bout de l'Ile switching station at Montreal. For the C.E.A., satisfactory operation of a trial 275,000 V airblast circuit-breaker at West Melton led to an order for a three switch station at this voltage, and subsequently to orders for two other large 275,000 V switching stations for the Authority. Included in the metalclad switchgear field were two 11,000 V 350 MVA distribution switchboards at Calder Hall "A" station and they received a repeat order for the Calder Hall "B" station.

Sales of motors and control gear covered a wide range of applications in factories, dockyards, research laboratories, testing stations and power stations at home and overseas. 1956 was a record year for orders received for rolling mill drives for both home and export, and in the mining field, sixteen winders totalling some 16,000 h.p. were put into commission. Valuable contracts were received in the textile field for the electrification of jute, cotton, wool and synthetic fibre mills at home and overseas, and the new design, development and extension of the range of industrial and f.h.p. motors bore good fruit in increased sales.

Some years ago they invested large sums in plant to produce electrical domestic appliances, but this business had been limited by restrictions on hire purchase and heavy purchase tax. Consequently, these plants had never been operating as they were designed to do.

Sir George concluded his statement by briefly reviewing the activities of the subsidiary and associated companies at home and overseas.

Marconi's Wireless Telegraph Co., Ltd.—In the course of his speech at the annual meeting held on 14th March Sir George Nelson, Bt. (chairman), said that new and important extensions to their research laboratories were in hand and would come into use during the current year. Referring to outstanding contributions by their scientists, he said that in the communications field they had made great advances in microwave radio links, the first of their kind using an all travelling wave tube technique in production. Advances had also been made in the ionosphere scatter technique making use of radio waves reflected from the base of the ionosphere. In the field of air navigation they had been in the forefront in developing and manufacturing a revolutionary airborne navigational aid of great accuracy known as the "Doppler Navigator." This device was unique in that it gave a continuous

pinpoint plotting of an aircraft's navigational position.

In Nigeria they had been awarded an additional contract for maintaining the Marconi multi-channel network and for the establishment of a training college under the auspices of their own Marconi College for the advanced training of Nigerian technologists. They had developed and put into production a series of high-power early-warning radars, and a further range of new equipment was under development.

They had been entrusted by the B.O.A.C. with the preparation of a radio system for their Comet IV aircraft, and their transmitter/receiver had been chosen for B.O.A.C.'s long-range Britannia airliners.

The most outstanding event of the year in the television field was the inauguration of television services in Australia. This task was completed in time for the Olympic Games. Marconi's were responsible for four of the first six stations, two in Sydney and two in Melbourne. For the recent demonstration of the progress of colour television in the House of Commons, the transmitting and camera equipment used by the B.B.C. were of Marconi design and manufacture. Orders received for the new range of v.h.f. f.m. transmitters included 12 for Sweden. Two high-power transmitters had been supplied for the new Baghdad station, nine for the Paradys station in South Africa, three for Cyprus and others for Ghana and Denmark.

The Marconi International Marine Communication Co., Ltd.—Speaking at the annual meeting held on 14th March, Sir George Nelson, Bt. (chairman), said that during the past year the shipping industry, both at home and overseas, had continued to go to Marconi Marine for the fitting of all types of radar and radio equipment for many new ships and also for additions to, or modernisation of, existing installations. Export business continued to expand as was demonstrated by the many orders received for radar, radio and echometers, particularly from foreign countries. They had also received many orders for equipping new tonnage building in Japan. Events in the Middle East had emphasised the importance and the flexibility of their world-wide service facilities and their depots were able to deal with the suddenly increased demand for service.

Associated Electrical Industries, Ltd.—The report and accounts for 1956 now issued confirm the preliminary figures given in our issue of 8th March. The directors, in their report, state that the value of goods dispatched from the factories of the group exceeded by £5·4 million the previous record. Orders received, both home and overseas, amounted to £137 million, against £143 million in 1955. There were orders in hand at the end of the year to the value of £152 million, compared with £145 million at 31st December, 1955. An order received for a nuclear power station has not been included in these figures. The percentage of United Kingdom export orders in hand was approximately the same as in the previous year.

Desoutter Brothers (Holdings), Ltd.—The main figures in the accounts for 1956 were given in our issue of 1st March. In his statement which accompanies the report and accounts, Mr. G. H. Webb (chairman and managing director) says that the reduction in Australian import licences has somewhat limited the expansion of the export trade, but efforts in other directions have resulted in an increase of over 11 per cent in the total export sales figures. During the year they received a large order through the Soviet Trade Delegation. The order book, although somewhat lower than at this time last year, is still healthy and keeps their productive capacity fully employed.

Veritys, Ltd.—An extraordinary general meeting was held on 18th March in Birmingham for the purpose of removing five of the existing directors and for the appointment of two new directors. After a discussion the first resolution, to remove Mr. G. S. Nott (chairman), was defeated on a show of hands, nine in favour and 24 against. A poll was demanded the result of which was 300,203 votes in favour and 264,174 against the motion, a majority of 36,029. Mr. Nott thereupon vacated the chair and four of the other directors (Messrs. H. B. T. Wilde, A. W. Hiley, R. S. Blackledge and N. C. Hodson) tendered their resignations. In view of the proxy voting announced on the first resolution the majority of the shareholders who were supporting the existing board agreed not to vote on the resolutions for the appointment of Mr. R. M. Mair and Mr. J. D. Shepard. The resolutions for their appointment were carried on a show of hands on the casting vote of the acting chairman.

Taylor, Tunnicliff (Electrical Industries), Ltd.—The main figures in the accounts for the year to 31st December last were given in our issue of 8th March. In his annual statement Sir John Kent (chairman) says an increase in production, together with the problems associated with rising costs and lower profit margins, have been the chief features of 1956, in which trading profit has been earned of £415,033, as compared with £407,531 for the previous year. After officiating as chairman of the company since its inception in 1938, he has decided to relinquish that appointment at the annual meeting to be held on 2nd April, and the board has asked Mr. J. V. Cooper to accept the chairmanship. In the main the order books of all the subsidiaries can be considered as satisfactory and have given a promising start in the current year.

Richard Johnson & Nephew, Ltd.—At an extraordinary general meeting held in Manchester on 15th March resolutions were passed increasing the capital to £3,900,000, capitalising £1,800,000 and authorising that this sum be distributed amongst ordinary shareholders in the proportion of one new ordinary share for every ordinary share held.

Stothert & Pitt, Ltd., have declared an interim dividend of 5 per cent (unchanged).

Franco Signs, Ltd.—Before providing £62,665 for taxation, the profit for the year to 30th September last was £113,812, as compared with £97,067 for 1954-55. The dividend for the year is 12½ per cent (against 12 per cent).

Enfield Rolling Mills, Ltd., has created £300,000 2½ per cent unsecured loan stock, 1972, and issued it in part payment of the purchase price for the capital of the Aston Chain & Hook Co.

Bakelite, Ltd.—The group profit for 1956 is £474,921, as compared with £645,725 for 1955, and after deducting taxation of £214,935, the net balance is £209,986 (against £337,325). It is proposed to pay a final ordinary dividend of 10 per cent (against 11 per cent), making 15 per cent (16 per cent) for the year.

Bankruptcies

J. F. Creasey, 5, Eccleston Crescent, Chadwell Heath, Romford, Essex, electrical installation engineer, formerly carrying on business under the name of Creasey Electrical Co., at 2, Regent Square, London, W.C.1, and 3, Fanshawe Avenue, Barking, Essex.—Last day for receiving proofs for dividend 22nd March. Trustee, Mr. W. J. W. Hill, 58-61, York Terrace, Regent's Park, London, N.W.1, Official Receiver.

G. A. Watts, 16, St. Martins Road, Stockwell, London, S.W.9, electrical engineer, and G. H. Watts, 32, Moat Place, Stockwell, S.W.9, electrician, lately carrying on business under the style of Watts & Watts at 185, Stockwell Road, S.W.9, and at 32, Moat Place, Stockwell, S.W.9, electrical engineers. Separate application of G. H. Watts.—Application for discharge to be heard on 5th April at Bankruptcy Buildings, Carey Street, London, W.C.2.

E. W. White, 5, Greenfield Road, Southmead, Bristol, electrical contractor.—Last day for receiving proofs for dividend, 27th March. Trustee, Mr. P. W. Hort, 26, Baldwin Street, Bristol, 1.

G. H. Evans, radio, electrical and television engineer, carrying on business at High Street, Mayfield, Sussex, in the name of G. H. Evans & Co.—Second and final dividend of 9s 9d in the £, payable at the offices of A. E. Orbell & Co., 7, Old Steine, Brighton, 1.

Liquidations

Law & Burns, Ltd., electrical contractors.—Winding up voluntarily. Liquidator, Mr. E. C. Jennings, 7, Winchester Street, South Shields, appointed 15th February.

H.G.B. Electronic, Ltd., radio and television dealers.—Winding up voluntarily. Liquidator, Mr. K. R. Cork, 19, Eastcheap, London, E.C.3, appointed 21st February. Particulars of claims to the liquidator by 30th April.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 27th March from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1946

31135. Bauer, S. G.—Nuclear reactors. 19th October, 1946. (771111.)

1951

11849. British Aluminium Co., Ltd.—Electrolytic treatment of metals. 14th May, 1952. (Cognate application 15903, 4th July, 1951.) (770950.)

1952

12440. British Thomson-Houston Co., Ltd.—Starter motors for internal combustion engines. 16th May, 1952. (770991.)

25891/2. Fielding & Platt, Ltd., and Henley's Telegraph Works Co., Ltd., W. T.—Extrusion apparatus. 19th November, 1953. (770871/2.)

1953

2962. Siemens & Halske Akt.-Ges.—Circuit arrangement for substantially simultaneous transmission of a number of communications through a common transmission path. 2nd February, 1953. (771058.)

4805. British Thomson-Houston Co., Ltd.—Magnetic ferrite materials. 22nd February, 1954. (770890.)

11462. Marbaix Industries, Ltd.—Apparatus for electric spark machining of metals. 21st April, 1954. (771235.)

18457. Automatic Coil Winder & Electrical Equipment Co., Ltd.—Electrical test probes. 29th July, 1954. (770892.)

22467. Swartwout Co.—Electrical control systems. 14th August, 1953. (771057.)

26893. Sylvania Electric Products, Inc.—Electrodes for gaseous electric-discharge devices. 30th September, 1953. (770893.)

27857. British Thomson-Houston Co., Ltd.—Navigational radar equipment. 11th October, 1954. (770894.)

31695. Pye, Ltd.—Electric signal distribution systems. 11th November, 1954. (770895.)

32288. British Thomson-Houston Co., Ltd.—Rectifier circuits. 19th November, 1954. (770896.)

32669. Plessey Co., Ltd.—A.c. generating systems. 13th January, 1955. (771240.)

32718. National Cash Register Co.—Electronic digital computers. 25th November, 1953. (770952.)

1954

2344. Tesla, Narodni Podnik.—Circuit for regulating the level of carrier frequency telegraphy with amplitude modulation. 26th January, 1954. (771061.)

4221. British Thomson-Houston Co., Ltd.—Arc furnace control systems. 9th February, 1955. (770997.)

5582. Pynford, Ltd.—Electric relay control devices. 25th May, 1955. (770900.)

7171. Walton, H. D.—Electrolytic cleaning of articles of metal. 11th March, 1954. (771314.)

10175. Imperial Chemical Industries, Ltd.—Electronic counters. 1st April, 1955. (Cognate application 31781, 3rd November, 1954.) (771053.)

10564. Siemens Bros. & Co., Ltd.—Electric lighting installations. 7th April, 1955. (770999.)

10872. Licentia Patent-Verwaltungs-Ges.—Electric impulse generator. 13th April, 1954. (770903.)

11263. Ericsson Telephones, Ltd., and Geddes, G. D.—Mounting arrangements for electrical apparatus. 2nd March, 1955. (770904.)

11415. Compagnie Générale de Télégraphie sans Fil.—Devices for decoupling between a number of ultra-high-frequency radiation sources. 20th April, 1954. (770905.)

11738. Lepazowa, L.—Electrical method of measuring the vital power of bacteria and apparatus therefor. 23rd April, 1954. (771245.)

12464. Raytheon Manufacturing Co.—Pulsed electron-discharge systems. 29th April, 1954. (771246.)

15861. Adamson, R. A.—Bits for electrically heated soldering irons. 31st May, 1955. (771247.)

16329. Mullard Radio Valve Co., Ltd.—Transistor oscillator circuit arrangements. 3rd May, 1955. (771003.)

16830. British Thomson-Houston Co., Ltd.—Electrical transmission line arrangements. 3rd June, 1955. (771004.)

20383. Visseaux Soc. Anon., J.—Deflection means for cathode-ray tubes. 12th July, 1954. (771066.)

22154. National Research Development Corporation.—Transistor oscillators. 19th July, 1955. (771067.)

22719. Brookhirst Switchgear, Ltd., and Chalmers, W. R.—Rotary snap-action electric switches. 3rd November, 1955. (771125.)

24313. Metropolitan-Vickers Electrical Co., Ltd.—Electrical pulse generating circuit arrangements. 16th August, 1955. (770777.)

25949. Hecla Electrics Proprietary, Ltd.—Automatic cut-off devices particularly for electric smoothing irons. 7th September, 1954. (770960.)

29453. Parsons, Ltd., C. H., and Handley, G. B.—Cord operated electric ceiling switches. 13th October, 1955. (771130.)

29759. Western Electric Co., Inc.—Semiconductor devices. 15th October, 1954. (771009.)

33565. Standard Telephones & Cables, Ltd.—Travelling-wave tube. 19th November, 1954. (771189.)

34172. Westinghouse Electric International Co.—Electrostatic precipitators. 25th November, 1954. (770921.)

37073. Indjoudjian, M. D.—Electrical delay networks. 22nd December, 1954. (770878.) 37074. Electrical pulse shaping networks. 22nd December, 1954. (770879.)

37547. Morphy-Richards, Ltd.—Toasters. 19th December, 1955. (771015.)

1955

577. General Electric Co.—Refrigerating apparatus. 7th January, 1955. (770968.)

2209. Philips Electrical Industries, Ltd.—Electronic differential amplifiers. 25th January, 1955. (771083.)

3664. Automatic Telephone & Electric Co., Ltd.—Electrical coil assemblies. 9th November, 1955. (770794.)

5304. General Electric Co.—Speed responsive centrifugal devices. 22nd February, 1955. (771021.)

5482. Piles Wonder.—Electric battery of the flat cell type. 23rd February, 1955. (771260.)

6511. Siemens & Halske Akt.-Ges.—Jointing arrangements for high frequency multi-layer cables consisting of alternate thin layers of metal and insulation. 4th March, 1955. (Addition to 744104.) (771339.)

7905. Automatic Telephone & Electric Co., Ltd.—Telephone or like systems. 18th March, 1955. (Addition to 766902.) (771342.)

10638/9/40 and 12038. Sperry Corporation.—Travelling-wave tube. 13th and 26th April, 1955. (770880-3.)

11694. Western Electric Co., Inc.—Switching circuits for communication systems. 22nd April, 1955. (770936.)

12185. Standard Telephones & Cables, Ltd. — Loudspeaker intercommunicating systems. 27th April, 1955. (770937.)

12766. Saia Akt.-Ges.—Electrical programme switches. 3rd May, 1955. (771146.)

15190. Time, Inc.—Systems employing gaseous discharge lamps. 26th May, 1955. (770885.)

16007. Lignes Télégraphiques et Téléphoniques.—Flexible tubes, for instance sheaths of electric cables and methods of manufacturing same. 3rd June, 1955. (770805.)

16210. Union Générale Belge d'Electricité.—Means for the indirect determination of the temperature of overhead electric cables. 6th June, 1955. (770813.)

16562. Standard Telephones & Cables, Ltd.—Electric-discharge devices. 9th June, 1955. (770817.)

17133. General Electric Co.—Air conditioning apparatus. 14th June, 1955. (770829.)

17134. General Electric Co.—Timing apparatus particularly for electric welding machines. 14th June, 1955. (771263.)

17385. Talon, Inc.—Electric toggle switch. 16th June, 1955. (770836.)

17425. General Electric Co.—Dish washing machines. 16th June, 1955. (770841.)

17759. Kinnane, R. F.—Gas-operated safety device for use with enclosed electric conductors and contrivances. 20th June, 1955. (771163.)

17952. General Electric Co.—Semi-conductor devices. 21st June, 1955. (771039.)

18474. Fielden Electronics, Ltd.—Pressure measuring devices. 27th June, 1955. (771040.)

18699. General Electric Co.—Mounting means for externally applied electric heating elements. 28th June, 1955. (770863.)

19320. Licentia Patent-Verwaltungs-Ges.—Electric high voltage outdoor insulator. 4th July, 1955. (771192.)

19343. Dings Magnetic Separator Co.—Magnetic separators. 5th July, 1955. (771090.)

20387. General Motors Corporation.—Electric switches operable by fluid pressure. 14th July, 1955. (771170.)

20528. Compagnie Industrielle des Téléphones.—Relay regenerator device for telegraph signals. 15th July, 1955. (770982.)

20816. Bosch Ges., R.—Commutators for dynamo-electric machines. 19th July, 1955. (771273.)

20827. Standard Telephones & Cables, Ltd.—Manufacture of cathode-ray tubes. 19th July, 1955. (771201.)

20966. Kolster-Brandes, Ltd.—Electric transformers. 20th July, 1955. (771171.)

21132. Philco Corporation.—Electrical apparatus. 21st July, 1955. (771276.)

21855. General Electric Co.—Rotatable shelf structures for storage compartments. 28th July, 1955. (771208.)

22013. Philips Electrical Industries, Ltd.—Synchronous motors comprising a cage armature. 29th July, 1955. (771280.)

22021. General Electric Co.—Electrical heating devices and control arrangements therefor. 29th July, 1955. (771210.)

22178. General Electric Co.—Method of and means for electromagnetic recording. 2nd August, 1955. (771212.)

22183. Maxson Corporation, W. L.—Snap-action switch. 2nd August, 1955. (770983.)

24135. Philips Electrical Industries, Ltd.—Ignitron circuit arrangements. 22nd August, 1955. (770985.)

24380. Sandoz, Ltd.—Circuits for a.c. commutator motors. 24th August, 1955. (771098.)

24590. General Electric Co.—Three-phase magnetic cores. 26th August, 1955. (771287.)

24610. Akt.-Ges. Brown, Boveri & Cie.—Damper winding for electric machines with multiple winding. 26th August, 1955. (771288.)

24998. General Electric Co.—Brush holder assemblies for electrical equipment. 31st August, 1955. (771292.)

25859. American Cyanamid Co.—Insulation for electric conductors. 9th September, 1955. (771183.)

25863. Siemens & Halske Akt.-Ges.—Telecommunication cables. 9th September, 1955. (771295.)

[*Continued on page* 547

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 25th March

BIRMINGHAM.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midland Radio and Telecommunication Group. "The B.B.C. Sound Broadcasting Service on Very-High Frequencies," by E. W. Hayes and H. Page.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Utilisation Group. "2/1 Pole-Changing Machines," by R. F. Burbidge, and "Coal Winding Electrically," by G. Davies.

LEEDS.—Town Hall. I.E.E. North Midland Centre. Faraday Lecture on "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

Lighting Service Bureau, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. Annual general meeting and film.

LEICESTER. — E.M.E.B. Demonstration Theatre, Charles Street, 6 p.m. I.E.S. Leicester Centre. Film show.

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduate and Student Section. "The Visit of the British Electricity Supply Delegation to the Soviet Union," by Sir Josiah Eccles.

NEWCASTLE-ON-TYNE.—Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "Earth Electrode Systems for Large Electric Stations," by J. D. Humphries.

Monday, 25th March, to Thursday, 28th March

LONDON.—Old and New Halls, Royal Horticultural Society, Westminster. Physical Society Exhibition of Scientific Instruments and Apparatus.

Tuesday, 26th March

BIRMINGHAM. — College of Technology, Gosta Green, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. Discussion on "The Teaching of Filter Theory," opened by R. O. Rowlands.

CHELMSFORD. — Public Library, 7 p.m. I.E.E. London Graduate and Student Section. District meeting. Film evening.

COVENTRY. — I.E.E. South Midland Graduate and Student Section. "Modern Trends in High Speed Oscilloscope Development," by G. A. Doherty.

EDINBURGH.—Scottish Lyceum Gallery and Restaurant, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. "The Engineering Equipment of Leith Docks," by M. C. White.

25, Charlotte Square, 7 p.m. I.H.V.E. Scottish Branch. "Testing of Heating and Air Conditioning Plants," by W. C. Ramsay.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Control and Radio Telecommunications Section. Discussion on "The Performance of D.C. Amplifiers with special reference to the use of Transistors," opened by K. Kandiah and Dr. G. B. B. Chaplin.

85, Minories, E.C.3, 5.30 p.m. Institute of Marine Engineers. "Developments in Marine Electrical Installations with particular reference to A.C. Supply," by A. N. Savage.

Mansion House, Portland Place, 6.30 p.m. Society of Instrument Technology. "Process Development and Plant Design—The Role of Instrumentation with particular reference to the Application of Computers," by S. T. Lunt.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurement and Control Group. Discussion on "Breakdown of Dielectrics," opened by C. G. Garton and J. H. Mason.

RUGBY.—College of Technology and Arts, 6.30 p.m. I.E.E. Rugby Graduate and Student Section. Annual general meeting and film evening.

Tuesday, 26th March and Wednesday, 27th March

MANCHESTER. — College of Science and Technology. Electronics exhibition, under the auspices of the I.E.E. North-Western Radio and Telecommunication Group.

Wednesday, 27th March

BARROW-IN-FURNESS. — North Western Electricity Board Demonstration Theatre, Duke Street, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. Informal discussion on "Progress in Switchgear," opened by C. H. Flurscheim.

CHESTER.—Kings Buildings, King Street, 7 p.m. Society of Instrument Technology, Chester Section. "The Future of Semi-Conductors in Industry," by D. D. Jones.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre. "Frequency Modulation Radar for Use in the Mercantile Marine," by D. N. Keep.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. "The B.B.C. Sound Broadcasting Service on Very-High Frequencies," by E. W. Hayes and H. Page.

HOVE.—New Imperial Hotel, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "Safety in Electrical Installation," by S. J. Emerson.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Earth Electrode Systems for Large Electric Stations," by J. D. Humphries.

Piccadilly Hotel, 12.30 for 1 p.m. Electric Light Fittings Association. Annual luncheon, guest speaker Sir Josiah Eccles. Followed by annual general meeting.

Connaught Rooms, W.C.2, 12.30 for 12.50 p.m. Batti-Wallahs' Society. Luncheon. Guest speaker, Mr. E. Blake.

At the London School of Hygiene and Tropical Medicine, Keppel Street, 6.30 p.m. British Institution of Radio Engineers. "Disc Recording," by Dr. G. F. Dutton.

SOUTHAMPTON.—The University, 7 p.m. I.E.E. Southern Centre. "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

WEMBLEY.—A.S.E.E. South West London Branch. Visit to the Research Laboratories, G.E.C., Ltd.

WOLVERHAMPTON.—A.S.E.E. Oxford, Reading and Districts Branch. Visit to the Electric Construction Co., Ltd.

Thursday, 28th March

EDINBURGH.—Central Hall, Tollcross, 7.30 p.m. I.E.E. Scottish Centre. Faraday Lecture, "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

KENDAL.—North Western Electricity Board Demonstration Theatre, Finckle Street, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. Informal discussion on "Progress in Switchgear," opened by C. H. Flurscheim.

LANCASTER.—Storey Institute, 7.30 p.m. Institution of Works Managers, Lancaster Group. "Electronics as Applied to Industry," by W. A. Turner.

LONDON.—85, Minories, E.C.3, 5.30 p.m. Institute of Marine Engineers. "An Introduction to Nuclear Power," by P. T. Fletcher.

NORWICH.—Assembly House, 7.30 p.m. I.E.E. East Anglian Sub-Centre. "Highland Water Power—The Development of the North of Scotland Hydro-Electric Board," by the late T. Lawrie (to be read by C. L. C. Allan).

SPALDING.—Masonic Hall, Pinchbeck Street, 7.15 p.m. I.E.E. East Midland Centre. "The 275 kV Line from Staythorpe to Sheffield," by J. D. Pierce.

Friday, 29th March

BIRMINGHAM. — Imperial Hotel, Temple Street, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch. "Torque Convertors." (Mobile Plant Discussion Group.)

BRISTOL.—Grand Spa Hotel, Clifton, 7 for 7.30 p.m. I.E.E. Western Centre. Annual dinner and dance.

Hawthorns Hotel. I.E.S. Bath and Bristol Centre. Dinner-dance.

CHELMSFORD.—Hoffman Social Club, 7.15 p.m. Chelmsford Engineering Society. Conversazione.

GLASGOW.—425, Sauchiehall Street, 7.15 p.m. Society of Instrument Technology, Scottish Section. Annual general meeting. "An Automatic Plant," by A. Stewart.

LEEDS.—Broadway Hall. A.S.E.E. Leeds Branch. Supper-dance.

LONDON.—Pepys House, Rochester Row, S.W.1, 7 p.m. Junior Institution of Engineers. "Making Use of Russian and Czech Scientific and Technical Information," by E. Gros.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Nuclear Engineering," by J. Diamond.

SHEFFIELD.—Royal Victoria Hotel, 7 for 7.30 p.m. I.E.E. Sheffield Sub-Centre. Dinner-dance.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. "Nuclear Power," by H. A. Roberts.

Saturday, 30th March

LONDON.—I.E.E. London Graduate and Student Section. Visit to Royal Opera House, Covent Garden, at 10.30 a.m.

SUNDERLAND. — I.E.E. North Eastern Graduate and Student Section. Visit to Cosmos Works, Edison Swan Electric Co., Ltd., at 10 a.m.

NEW PATENTS (*continued*)

26064. General Electric Co.—Three-legged laminated magnetic cores. 12th September, 1955. (771296.)

26122. Brunt, C. H.—Electric motors. 13th September, 1955. (771297.)

26605. General Electric Co.—Thermal protection of electric motors. 16th September, 1955. (771219.)

27343. Haefely & Cie. Akt.-Ges., E.—High voltage machines for the production of high speed electrically-charged particles. 26th September, 1955. (771222.)

27501. Siemens & Halske Akt.-Ges.—Telecommunication exchange circuit arrangements. 27th September, 1955. (771101.)

29717. General Electric Co.—Polyphase generators. 18th October, 1955. (771300.)

30723. Allmänna Svenska Elektriska Aktiebolaget. — Instantaneously available reserve power plant particularly for use with telecommunication plants. 27th October, 1955. (771226.)

30937. General Electric Co.—A.c. electric motors of the induction type. 28th October, 1955. (771227.)

31476. Philips Electrical Industries, Ltd.—Devices for maintaining mechanical oscillations. 3rd November, 1955. (771229.)

33617. General Electric Co.—Method of detecting leaks and testing media for that purpose. 23rd November, 1955. (771051.)

34575. General Electric Co.—Slot wedge for dynamo-electric machines. 2nd December, 1955. (771109.)

34605. Siemens & Halske Akt.-Ges.—Electric circuit arrangement for the simultaneous transmission of a plurality of communications. 2nd February, 1953. (Divided out of 771058.) (771059.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—Electricity Trust of South Australia, Adelaide. 2nd April. 3,000 electrical time switches.

Durham.—County Education Committee. Electrical installation at Chester-le-Street C.E. Controlled School, Trimdon Parochial School and Willington County School. County architect, South Street, Durham.

Greece. — State Procurement Service, Ministry of Finance, Athens. 11th April. Portable lead storage batteries. (E.S.B. 6505/57. Ten/24698.)*

India.—India Store Department. 1,000 junction remote controls. (See this issue.)

Director General of Supplies and Disposals, New Delhi. 26th April. 31 inert cells. (E.S.B. 5712/57. Ten/74636.)*

Bombay Electricity Board. 29th March. Substation equipment. (E.S.B. 6375/57. Ten/24743.)*

Madhya Pradesh Electricity Board, Nagpur. 3rd April. House service electricity meters. (E.S.B. 6593/57. Ten/24721.)*

Iraq.—Ministry of Interior, Directorate General of Municipalities, Baghdad. 20th April. Submarine cable and cable boxes. (E.S.B. 5871/57. Ten/24637.)* 27th April. Two 100 kW generating sets with switchboard and mechanical cooler. (E.S.B. 5873/57. Ten/24633.)* Two 100 kW sets, h.v. and l.v. switchboards, one 150 kVA, one 50 kVA and two 25 kVA transformers. (E.S.B. 5809/57. Ten/24632.)* 24th May. One 150 kW generating set with switchboard and cables. (E.S.B. 5872/57. Ten/24634.)*

Development Board, Ministry of Development. 22nd April. Line fittings for 132 kV and 33 kV transmission lines. (E.S.B. 6048/57. Ten/24660.)* 6th May. String insulator units. (E.S.B. 6047/57. Ten/24652.)*

New Zealand.—Post and Telegraph Department, Wellington. 12th April. Junction boxes. (E.S.B. 6090/57. Ten/24656.)* 18th April. Telephone jacks, suppressors and terminals. (E.S.B. 6493/57. Ten/24693.)*

State Hydro-Electric Department, Wellington. 25th June. 11 kV switchgear. (E.S.B. 6089/57. Ten/24657.)*

Nottinghamshire.—County Council. 13th April. Street lighting installation. (See this issue.)

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 10th April. Battery charging apparatus. (E.S.B. 5323/57. Ten/24630.)*

Rhodesia and Nyasaland.—Federal Tender Board, Causeway. 29th March. Telephone wire. (E.S.B. 5715/57. Ten/24610.)* Telephone cross arms. (E.S.B. 6702/57. Ten/24742.)*

St. Neots.—U.D.C. 15th April. Two electrically driven vertical spindle borehole pumps. John Taylor & Sons, Artillery House, Artillery Row, London, S.W.1.

Salford.—City Council. 27th April. Lamps and cables for the year ending 30th June, 1958. (See this issue.)

Seaham (Durham).—U.D.C. Electrical installations in 100 "Homeville" houses. A. M. Smith, surveyor, Cliff House, Seaham.

South Africa.—Union Tender and Supplies Board. 4th April. 250 detectors. (E.S.B. 6223/57. Ten/24689.)* 100 tie line relay sets. (E.S.B. 6225/57. Ten/24690.)* 250 portable magneto telephones. (E.S.B. 6220/57. Ten/24680.)* Cantop protectors and terminal boxes. (E.S.B. 6226/57. Ten/24674.)* 14th April. 150 bell type transformers. (E.S.B. 6301/57. Ten/24676.)* 25th April. Cable and cable fittings. (E.S.B. 6224/57. Ten/24677.)*

Stores Department, South African Railways, Johannesburg. 10th April. Switchboards. (E.S.B. 6227/57. Ten/24675.)* 12th April. Electric lamps. (E.S.B. 7042/57. Ten/24792.)*

Durban Corporation. 12th April. Street lighting lanterns. (E.S.B. 6377/57. Ten/24756.)*

United States.—Bureau of Reclamation, Denver. 4th April. 2,500 V metal-enclosed indoor type motor control equipment. (E.S.B. 6415/57. Ten/24751.)*

Uruguay.—Administración Naciónal de Combustibles Alcohol y Portland. 5th April. Porcelain insulators and lightning conductors. (E.S.B. 5850/57. Ten/24714.)*

West Hartlepool.—Corporation. 19th April. Electrical installation in connection with alterations and additions to West Hartlepool Girls' High School. L. Auton, architect, Regent Buildings, York Road, West Hartlepool.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Durham.—County Education Committee. Electrical work at schools: Washington Grammar Technical School (£11,951).—Devereux Moodie & Co. West Hartlepool, Wingate A. J. Dawson Grammar School (£400).—B. French. Stanley Towneley Memorial R.C. Modern School (£874).—G. B. Woods, Ltd. Barnard Castle New Modern School (£7,106).—J. Paterson & Co.

Eccles.—Highways and Town Planning Committee. Erection of street lighting columns, fittings and equipment (£3,145).—Erecon. Supply of fittings and equipment (£1,028).—General Electric Co.

Peterborough.—Housing Construction and Slum Clearance Committee. Electrical installations in 50 houses (£1,079).—Peterborough Electrics. Installations in 36 bungalows (£655).—M. F. Hansen.

Pontypool.—U.D.C. Electrical work in 82 houses at Trevethin (£2,373).—S. Loveday & Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Buxton.—Block of shops (12) and flats (24), Victoria Park estate, Fairfield; George Robb, architect to B.C., Lintols, Manchester Road, Chapel-en-le-Frith.

Gateshead.—Factory, Team Valley estate, for Huwood Co., Ltd. (£30,000); H. D. Burton, Ltd., King Street, North Shields.

Glasgow.—Motor bus garage, Mosspark Drive/Corkerhill Road site (£140,000) and additions to Hampden Trolley-bus Garage; Major A. G. Jury, city architect, 20, Trongate, C.1.

Godalming.—Factory, Catteshall Lane; Ingram & Glass, Ltd., Ingla Works, Haslemere.

Guildford. — Civic hall (£200,000); Bridgwater & Shepheard, architects, 42, Bruton Place, London, W.1.

Hebburn.—Houses (70); U.D.C. surveyor, Council Offices.

Keynsham.—Houses (32), West Park estate; George R. Ashton, clerk to U.D.C., Council Offices, Keynsham, Bristol.

Leeds.—Departmental store, restaurant, etc., on the Theatre Royal site; Schofields (Leeds), Ltd., drapers, etc., 79, The Headrow.

Leyton.—Houses (94), Ive Farm site, Church Road; D. J. Osborne, town clerk, Town Hall, London, E.10.

Factory, Church Road; Charles Lewis Shoes, Ltd., 46-48, Carlisle Road, London, E.10.

Litherland.—Houses (138), Ford estate; U.D.C. surveyor, Town Hall, Litherland, Liverpool, 21.

London.—Showrooms and offices, 19-20, Berners Street, Westminster; T. Mortimer Burrows & Partners, architects, 44, Bedford Row, W.C.1.

St. Paul's Church, Lorrimer Square, Walworth; Woodroffe, Buchanan & Coulter, architects, 5, Bedford Row, W.C.1.

Luton.—Laboratories and offices at Sewage Disposal Works; borough architect.

Lutterworth (Leics).—Houses (16), Swiftway; R.D.C. architect.

Manchester.—Nine-storey block of shops and offices, Market Street/Market Place site; Unicos Property Corporation, Ltd., 43, North Audley Street, London, W.1.

Buildings for Departments of Mathematics and Geology of University; R. R. Jennings & Partners, consulting engineers, 35, Byrom Street.

Morpeth.—Reconstruction of St. George's Hospital (first stage) for Newcastle Hospital Board (£41,000); John Jackson & Sons, builders, Corporation Street, Newcastle-on-Tyne.

Newcastle-on-Tyne.—Flats and maisonnettes (104), Kenton North estate; Thomas Armstrong, Ltd., builders, Robson Street.

Stafford.—Houses (107), Great Haywood, Colwich, for R.D.C.; Watkin, Willis & Cooper, architects to Council, National Provincial Bank Chambers, Burslem, Staffs.

Surbiton.—Rebuilding Southampton Hotel, St. Mark's Hill; S. Tiltman, architect, 38, East Street, Brighton.

Swansea.—Erection of new bank premises at the Kingsway; Lloyds Bank, Ltd., 71, Lombard Street, London, E.C.4.

Thetford.—Houses (200), as initial stage of scheme to provide houses, etc., for London overspill; borough engineer, Guildhall, Thetford, Norfolk.

Thornaby (Yorks).—Housing developments at Mandale Farm for the Lascelles Estates, Ltd.; A. W. Watts & Co., The Estate Office, Northallerton.

Tottenham.—Dwellings (112), Weir Hall Road; borough engineer.

Tynemouth.—Housing development in Preston Road for J. H. James & Son, builders, Archer Street, Wallsend.

Uxbridge. — Dwellings (48), Midhurst Gardens estate; borough engineer.

Walthamstow.—Maisonnettes and flats (32), The Drive and Prospect Hill; borough architect.

Warrington.—Bus garage, Mill Lane; Lancashire United Transport, Ltd., Bridgefoot, Warrington.

Warwick.—Houses (83) and five blocks of flats, Percy estate; H. S. Brown, borough surveyor, 23, Jury Street.

Weston-super-Mare.—St. Andrew's Church, Coniston Crescent; A. Rainey & Son, Ltd., builders, Milton Road.

Woking.—Shops and offices, Commercial Road; A. J. & L. R. Stedman, architects, 36, South Street, Farnham.

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